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DEFOLIATION OF TROPICAL JUNGLE VEGETATION IN HAWAII

Technical Report

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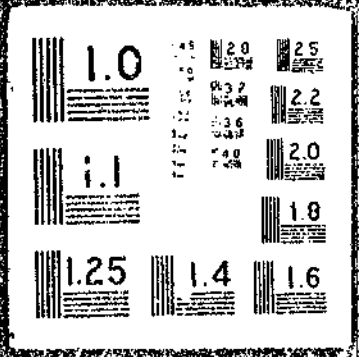

FINAL REPORT

DEFOLIATION OF TROPICAL JUNGLE VEGETATION IN HAWAII

by

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Contract DAAA 13-67-C-0163

May 1, 1967-- June 30, 1968

DEPARTMENT OF THE ARMY
FORT DETRICK, FREDERICK, MARYLAND

DEPARTMENT OF AGRONOMY AND SOIL SCIENCE
UNIVERSITY OF HAWAII
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JUNE 1968

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DEFOLIATION OF TROPICAL JUNGLE VEGETATION IN HAWAII

INTRODUCTION

Dense tropical and sub-tropical areas of inaccessible by mechanical means for land improvement. Aerial application of defoliants and systemic herbicides is potentially the most economically feasible manner by which conversion from impenetrable jungle to productive grasslands can occur.

The investigations reported herein are an effort to establish the effectiveness of various defoliating and systemic herbicides in vegetation control in the numerous types of jungle species prevalent in Hawaii. The report deals only with responses of woody species to these chemicals over a period of time and does not include any economic aspects involved in jungle clearance.

The main objective of this research was to evaluate the rapidity of action and the degree and duration of defoliation and damage on trees and shrubs of Hawaii to aerial applications of selected chemicals and chemical mixtures. The investigation was divided into four categories as follows:

Series I: Rapid defoliants

Series II: Rapid defoliants--rates and volumes

Series III: Rapid defoliant--systemic combinations

Series IV: Systemics

EXPERIMENTAL SITE DESCRIPTIONS

Series I

The test site is located on the Sam Thronas leasehold in the Wailua Game Refuge approximately 2 miles north of the Kauai Branch of the University of Hawaii Agricultural Experiment Station. The area lies at 500 feet elevation and receives 80-90 inches of rainfall annually.

The topography is very rough with several steep ridges and deep valleys extending through the experimental site (Photo 1). Ridges provided satisfactory locations for access roads and placing plot markers (flags). The base-line is a permanent dirt road. Accessibility for vehicles were made on the ridges with a bulldozer.

Trails were cut through the center of each 2-acre plot to provide access into individual plots for tagging, rating, and photographing. Mr. James M. Russ, sub-contractor on this project, provided crews for trail-cutting. The 32 plots in this series were generally 1,000 feet in length, but due to the dose proximity of the ridges, those in replication B were considerably shorter. Plot lengths, therefore, varied from a distance of less than 500 feet to more than 1,300 feet. The two non-randomized replicates (A and B) were continuous from one plot to the other.

Series II

Replication A is located in the vicinity of series I (Photo 1) and replication B is situated approximately 2 miles south at the 530 feet elevation (not shown). The latter is just west of the Bauxite Reclamation Project conducted by the University of Hawaii Agricultural Experiment Station. Both areas receive rainfall essentially similar to that of series I.

The uneven and steep terrain of replication B vastly differs from replication A where the topography is more favorable for aerial application. In replication B, a 200-feet gully traversed across the direction of the plots hampering precise aerial application. Plot lengths averaged about 900 feet in replication A and 1,300 feet in replication B.

Series III

The experimental site is located in the Waikoko Block of the reforestation project, Hanahanapuni, Hawaii Department of Land and Natural Resources, Division of Forestry. It is approximately 5 miles southwest of the Kauai Branch Station. It lies at the 850 feet elevation and receives about 150 inches of rainfall annually.

Replication A has a fairly steep topography extending from a ridgetop to Waikoko stream approximately 1,000 feet away (Photo 2). The vegetation originally in the partially cleared area shown in Photo 2 was used as stream

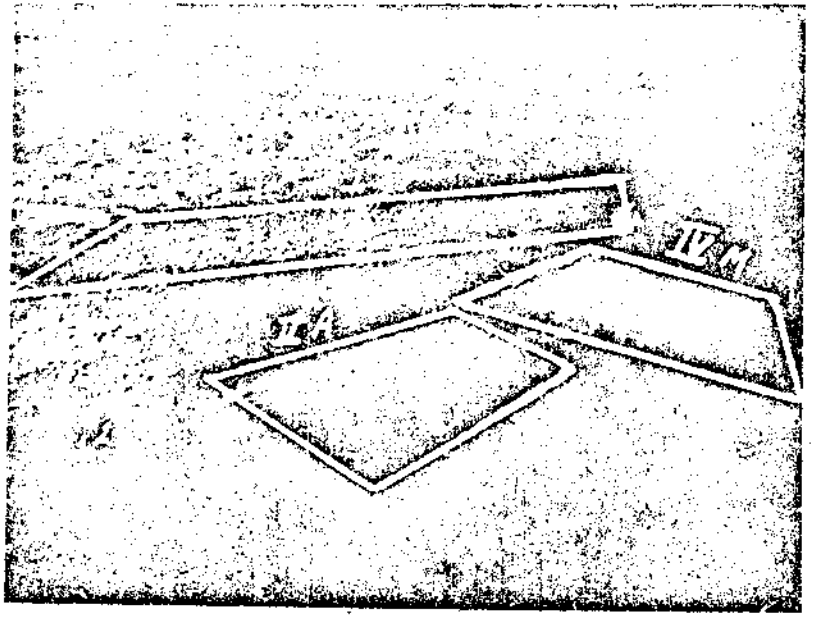

Photo 1: Location of Series I, Series IIA, and Series IVM in the Wailua Game Refuge.

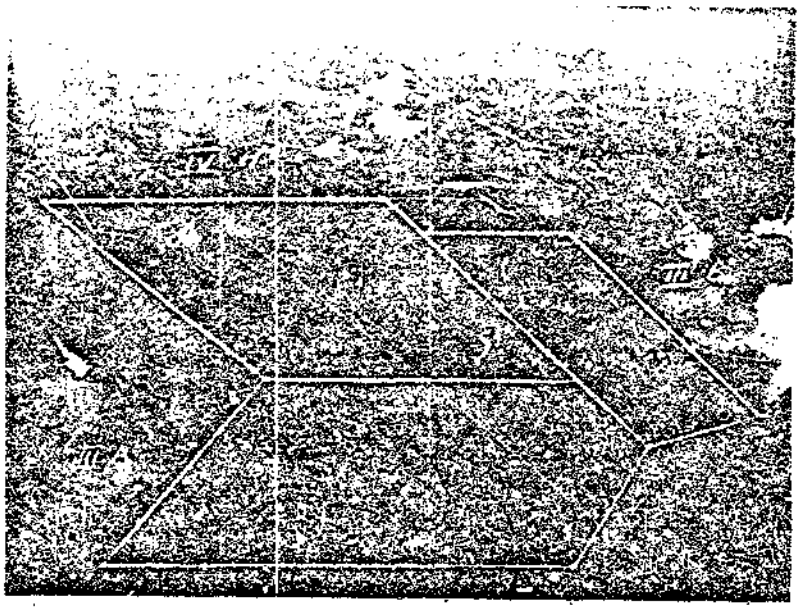

Photo 2: Location of Series IIIA, Series IIIB, and Series IVH in the Waikoko Block, Hanahanapuni.

fill-in in order to provide accessibility to series IIIB and IVH. Plot preparation in this area was time-consuming due to the uneven terrain and boggy conditions which prevented the efficient use of bulldozers. Access roads, when completed, extended around the perimeter of replication A. Each 2-acre plot was clearly marked with a definite colored flag from a red-blue-yellow-green-white color sequence.

Replication B was installed in a difficultly-accessible area and considerable problems with road-building were faced. The road adjoining series IIIA and IVH was used as a base-line for IIIB (Photo 2). However, since heavy equipment could not build any roads on the far end of the plots, all additional means of accessibility were done by hand. A 35-feet gully traversed through the center of the entire replication. The plots were generally slightly less than 2 acres.

Series IV

A single replication of 19 five-acre plots were installed. Series IVH included plots (also treatment numbers) 1 to 13 and was located at Hanahanapuni (Photo 2). Series IVM included plots 14 to 19 and was located at Moalepe in the Wailua Game Refuge (Photo 1).

Series IVH, adjacent to series IIIA, has four main ridges extending through the test area. Access roads on these ridges permitted the placement of marker flags. Plots 12 and 13 had to be cut by hand since the steep ridges prevented heavy equipment from being utilized. The plots averaged about 1,350 feet in length.

Series IVM was easily accessible and the rolling topography permitted ready placement of colored flags. This site was selected because of the high grass composition which was favorable for studying the effect of two specific chemicals.

DESCRIPTION OF VEGETATION

The selection of a location for studying chemical defoliation depended largely on the variability and woody species found in that particular area in addition to accessibility. Diversity and variability were desired so that any information obtained in the test would be applicable over a wide area. The wide diversity of vegetation found in Hawaii permitted the installation of all four series in close proximity to the Kauai Branch Station.

A brief morphological description of each significant vegetative specie found in the test sites will be given. Only 5 or 6 of the described woody species were common to all four locations. Others are listed since enough individuals could be found in plots of several series.

Psidium guajava. GUAVA

A small branching tree generally under 25 feet tall with smooth bark; leaves oval to oblong, smooth on top, slightly hairy beneath, 3 to 6 inches long;

flowers white; ripe fruit yellow, the size of lemons. Grows in scattered stands of smaller shrubs on ridgetops and open areas and dense thickets of larger trees along streambeds.

Metrosideros collina polymorpha. OHIA-LEHUA; LEHUA

An extremely variable plant ranging from tall trees to low thick shrubs, but generally 20 to 30 feet tall; leaves smooth and shiny on the upper surfaces and smooth to tomentose on the undersides. Usually found growing on soils of poor fertility.

Eugenia cumini. JAVAPLUM

A branching tree generally 30 to 40 feet tall with a smooth and conspicuously white bark; leaves lance-shaped, smooth, 3 to 6 inches long. A fast growing tree which forms a thick canopy shading out other vegetation.

Melastoma malabathricum. MELASTOMA

A spreading much-branched shrub 4 to 8 and sometimes up to 15 feet high with narrow oval pointed leaves, 2 to 6 inches long, covered with small stiff hairs on both sides. A prolific seeder which grows in large aggressive stands forming dense intertwining thickets crowding out other vegetation.

Lantana camara. LANTANA

A thorny branching shrub 3 to 6 feet and sometimes up to 15 feet high with ovate, rough, and somewhat wrinkled leaves. An aggressive plant that forms dense spreading stands crowding out other vegetation.

Pandanus odoratissimus. HALA; PANDANUS; SCREWPINE

A wide-branched native tree 20 or more feet tall with a few to many conspicuous aerial roots; leaves 3 feet or more in length, narrow, smooth, with sharp toothed margins, arranged spirally on branches. Grows in scattered stands where the male and female are separate plants.

Psidium cattleianum. STRAWBERRY GUAVA; WAIWI

A small tree with smooth bark and smooth, shiny, dark-green, egg-shaped leaves. Two edible fruited varieties found: The red-fruited variety grows 5 to 15 feet tall forming dense stands; the yellow-fruited variety (var. lucidum) grows 20 to 35 feet tall with a dense canopy shading out other vegetation.

Schinus terebinthifolius. CHRISTMASBERRY; BRAZIL PEPPERTREE

A large bushy, spreading shrub 10 to 15 feet high; leaves odd-pinnate with 5 to 9 leaflets, leathery, smooth. A fast spreading shrub that grows in scattered stands forming dense canopies shading out other vegetation. Male and female found on separate plants where female produces many small bright red fruits.

Grevillea robusta. SILVEROAK; SILKYOAK

A fast growing tree 60 or more feet tall, with fern-like leaves, twice divided, with smooth upper surfaces and silky hairy undersides. A heavy seeder that produces winged seeds which are easily disseminated forming scattered stands over wide areas.

Rhodomyrtus tomentosa. RHODOMYRTUS; DOWNY ROSEMYRTLE

A downy shrub 5 to 15 feet high with stiff elliptic leaves of smooth shiny upper surfaces and undersides covered with fine hair. A prolific seeder which forms dense stands of impenetrable thickets.

Cinnamomum camphora. CAMPHOR TREE

A dense erect tree 30 or more feet tall; leaves ovate, 2 to 5 inches long, shiny dark green above, whitish beneath, emits a strong odor of camphor when crushed. A handsome tree with thick conspicuously dark green foliage growing in scattered stands.

Hibiscus tiliaceus. HAU

A freely branching tree up to 40 feet tall; leaves rounded heart shaped; 2 to 12 inches in diameter, nearly smooth and somewhat shiny on upper surface, white with matted hairs beneath. Grows in large stands of horizontally spreading entangled network of trunks and branches forming impenetrable thickets usually along streams.

Syzygium sandwichensis. OHIA-HA

A small native tree up to 25 feet tall; leaves obovate to oblong, smooth, yellowish-green, with a reddish midrib. Grows in scattered stands usually in moist areas along streams.

Ilex anomala f. sandwichensis. KAWAU; AIEA

A branching native tree 20 feet or more in height, but occasionally a shrub; leaves oval to obovate, shiny, dark green, with a marked network of veins. Grows as scattered individuals in moist fern covered areas, conspicuous because of its shiny dark green color.

Straussia sp. KOPIKO

A small native tree usually under 15 feet tall; leaves ovate to obovate, 4 to 6 inches long, shiny, smooth or very sparsely hairy. Found in scattered stands usually as undergrowth.

Elaeocarpus bifidus. KALIA

A small tree up to 20 feet tall with drooping branches and branchlets which are gummy at the tips; leaves ovate smooth, leathery 4 to 7 inches long. Found as scattered individuals in fern covered areas usually with a few bare branches, partially denuded for some undetermined reason.

Dicranopteris linearis. FALSE STAGHORNFERN; ULUHE

A dense terrestrial fern with creeping underground rhizomes and wiry frondstems several feet in length; fronds divides repeatedly and at the end of each is a pair of pinnae cut into many small lobes. Grows as a dense advancing thicket smothering other vegetation.

Nephrolepis exaltata. SWORDFERN. BOSTONFERN

A medium sized terrestrial or epiphytic fern with creeping rhizomes and long arching fronds 2 to 4 feet long, which are cut into many narrow segments opposite along an axis. Grows as scattered tufts on ground or on trunks of trees, but sometimes forming thick patches of ground cover crowding out other vegetation.

Pteridium aquilinum. BRACKEN

A terrestrial fern with creeping underground rhizomes and 2 to 4 feet long frond stems; fronds triangular in shape, much divided, dull green, leathery. Found as scattered tufts in open areas, usually mixed with other ferns.

Paspalum conjugatum. HILOGRASS; SOURGRASS

An extensively creeping, pale yellowish-green, leafy perennial with flattened runners; flowering stem erect with 2 or rarely 3 spreading racemes. A persistent, easily propagated grass with little forage value that will grow even on poor acid soils.

Paspalum orbiculare. RICEGRASS

A bunchy, coarse, erect, bluish-green perennial; flowering stems erect with 4 to 6 spreading racemes. A persistent grass with little forage value that will grow on poor soils even where only a few other grasses can grow.

Setaria glauca. YELLOW FOXTAIL

A semi-prostrate light green annual; flowering stems erect with a brownish-yellow spikelike panicle. A heavily seeding grass with very little or no forage value that grows in all areas and does especially well on wet, poor, acid soils.

Melinis minutiflora. MOLASSESGRASS

A freely branching, spreading perennial forming a thick, but loose mat with a purple tinged foliage; flowering stems erect with a panicle of purplish bristled spikelets. A fast growing grass with good forage value and does well on poor acid soils.

The approximate composition of the various species found in each replication of each series are presented in Table 1. The principal woody species generally were guava, ohia, java plum, melastoma, and lantana. Where java plum stand was insignificant, some of the native species such as aiea and ohia ha were rated.

Rhodomyrtus was found in sufficient density only in series IIB. Christmasberry, waiwi, hala, hau, and the ferns provided additional information on the effects of the various defoliants and systemic herbicides. These species were generally interspersed throughout each series.

The annual and perennial grasses were consistently rated especially in series IVM where a grass understory was a requirement in evaluating the performance of picloram-dalapon combinations.

EXPERIMENTAL MATERIALS AND METHODS

Experimental Materials

The chemicals, adjuvants, and solvents utilized in this investigation are listed in Table 2. Except for local procurement of silvex, multifilm X-77, and diesel oil, the chemicals were provided by the Department of the Army, Fort Detrick, Maryland.

TABLE 1: APPROXIMATE COMPOSITION OF VARIOUS SPECIES IN TEST AREAS (PERCENT OF TOTAL AREA) [a/]

Series	Guava	Ohia	Java Plum	Melastoma	Lantana	Hala	Other Natives[e/]	Grasses	Ferns	Others
IA	29	12	3	15	5	4	--	11	15	6
IB	18	8	1	17	8	4	--	23	18	3
IIA	23	13	2	26	13	2	--	5	8	8[b/]
IIB	15	5	5	19	4	2	--	17	18	15[c/]
IIIA	1	18	--	10	--	--	1	--	67	1
IIIB	3	58	--	13	4	--	5	--	15	2
IVH	3	30	1	15	1	--	2	--	47	1
IVM	13	3	2	23	5	1	--	25	22	6[d/]

a/ Mean of two observations
b/ Mostly christmasberry and waiwi
c/ 13% rhodomyrtus
d/ 2% each of hau and waiwi
e/ Indigenous

TABLE 2: CHEMICALS, ADJUVANTS, AND SOLVENTS INCLUDED IN U. S. ARMY TEST PROGRAM

Chemical	Description
AP-20	3 lbs/gal. water-miscible formulation
DES-I-CATE	Liquid containing 0.52 lb/gal. of endothall (Disodium 3, 6-endoxohexahydrophthalate) as monomethyl cocoamine salt.
Diesel Oil	Standard Oil Co. diesel fuel (PS-200), Fed. Spec. VV-F-800, Grade DF-2.
Diquat	2 lb ion/gal as 1, 1'-Ethylene-2, 2'-dipyridylium dibromide.
DNBP	5 lb/gal. Dinitro-o-sec-butylphenol.
Dowco 224	2, 4-D butyl ester
HCA-2, 4, 5-T	2 lb/gal. Hexachloroacetone and 1 lb/gal propylene glycol butyl ether ester of 2, 4, 5-Trichlorophenoxyacetic acid.
L-249	Surfactant from Colloidal Products, Co.
L-251	Surfactant from Colloidal Products, Co.
M2628 (TORDON 101)	0.50 lb/gal picloram (4-amino-3, 5, 6-trichloro-picolinic acid) and 2 lb/gal 2, 4-D (2, 4-Dichlorophenoxyacetic acid).
M3140	1 lb/gal picloram ester, 2 qt/gal ORANGE and 1 qt/gal penola oil.
M3142	4 lb/gal picloram ester.
Multifilm X-77	Surfactant from Colloidal Products, Co.
ORANGE (M3151)	Contains 50% 2, 4-D and 50% 2, 4, 5-T n-butyl esters.
Paraquat	2 lb/ion/gal as 1, 1'-Dimethyl-4, 4'-bipyridylium dimethylsulfate.
Pentachlorophenol	4 lb/gal PCP
PHYTAR 560G	3.1 lb/gal cacodylic acid.
QI-99	4 lb/gal pentachlorophenol and 4 lb/gal propanil (3, 4-Dichloropropionanalide) in a 1:1 mixture of mesityl oxide and diacetone alcohol.

Table 2, Cont.

Chemical	Description
Silvex (KURON)	4 lb/gal. low volatile propylene glycol butyl ether ester of 2-(2, 4, 5-Trichlorophenoxy) propionic acid.
TORDON 22k	2 lb/gal of picloram-potassium salt.

Experimental Methods

Series I: Rapid Defoliants

Herbicide treatments were applied on July 24, 1967 by Murrayair, Ltd. following a long delay. There were 16 treatments with 2 (A and B) replications (Table 3). Treatments 13 and 16 are check plots. These treatments were not randomized for easier aerial application. The treated plots were 80 x 1000 feet minimum. The basic spray application was 10 gallons per acre with a multiple of this when rates were doubled.

Meteorogical conditions during spray application were as follows: temperature, 77°F; rainfall, none; relative humidity, ca. 69%; wind velocity, early morning 5 m.p.h. easterly, later about 10-15 m.p.h. As the winds increased, from treatment 8 to completion, considerable mauka (toward the mountain) drift was observed.

For about a month following application, diurnal temperatures ranged between 74° and 82°F. Rainfall was 1.05, 0.57, 2.02, and 3.32 inches at the 4, 7, 14, and 30 day rating periods, respectively, giving a combined total of 6.96 inches for the one-month period following application.

Ratings were made at the previously specified periods and on a monthly basis thereafter. Ratings were generally made by 4 persons knowledgeable of the rating system utilized. Instead of using the percent defoliation or desiccation system as suggested in the contract, a decimal system was used for separate visibility (defoliation) and injury (damage) effect as follows: 1-none, 3-slight, 5-moderate, 7-serious, 9-severe, and 10-complete or dead. The term "visibility" indicates that the rater is able to see through the canopy and is distinguishable from desiccation whereby foliage may be completely dead but has not abscissed and dropped. "Injury" includes the overall damaging effect on each species. A general evaluation of the entire plot was not made.

Prior to application, a single plant representing a principal woody species in each plot was tagged and photographed. There were generally 5 or 6 photographed species in each plot. All individual species were photographed with Kodak black-and-white panatomic-x film and overall shots were taken using Kodachrome II. These were filed as 3 x 5 inch black-and-white prints and as colored 2 x 2 inch slides, respectively. Photographs, both individual and overall, were taken simultaneously with each rating period. Aerial photographs were also taken on September 5, 1967 (7 weeks after application) and October 17, 1967 (13 weeks after application).

Several problems were encountered in this initial test. Since DNBP was dropped from the original plan, silvex was incorporated as treatments 11 and 12. Of the 20 gallons required for this test, 15 gallons was a 4 lb/gal formulation and 5 gallons as a 6 lb/gal formulation. This was due to the insufficient supply of a single formulation locally.

Several colored cloths used as flag markers in the red-blue-orange-yellow-white-pink-green-tan color sequence had faded considerably by application time and the pilot had difficulty seeing them. In replicate B, treatment 1 crossed over

TABLE 3: TREATMENT SCHEDULE FOR SERIES I

Treat. No.[a]	Chemical	Rate lb/A	Chemical Vol. gpa	Load No.	Volume Req'd Chemical	Volume Req'd Water	Gallons Total
1	Paraquat	4.7	3				
2	Paraquat [b]	9.4	6	1	40	130	170
3	Diquat	6	3				
4	Diquat	12	6	2	39	91	130
5	PCP	12	3				
6	PCP	24	6	3	39	91	130
7	PCP	40	10	4	50	--	50
8	PHYTAR 560G	6	2				
9	PHYTAR 560G	12	4	5	26	104	130
10	PHYTAR 560G	18	6	6	30	20	50
11	Silvex	7	1.5				
12	Silvex	14	3	7	20[c]	110	130
14	HCA-2,4,5-T	6+6	3				
15	HCA-2,4,5-T	12+12	6	8	39	91	130

a/ Treatments 13 and 16 are checks.
b/ Paraquat rates recalculated due to error made during loading of aircraft.
c/ 15 gal.-4ppg and 5 gal.-6ppg silvex.

to treatment 2, treatment 4 crossed treatment 5, treatment 8 crossed treatment 9, and treatment 9 crossed treatment 10, especially at the far end of the plots. The crossed areas were not evaluated during rating periods.

The multiplicity of 5-gallon containers used in transferring chemicals from 55-gallon drums to the aircraft increased ground time. Transfer of chemicals shipped in 5-gallon containers was fairly rapid and practical.

Series II: Rapid Defoliants--Rates and Volumes

Treatments were applied on October 9, 1967 (treatments 1 to 9) and October 15, 1967 (treatments 10 to 14). The 2 (A and b) replications, each consisting of 14 treatments, were applied by Murrayair, Ltd. (Table 4). Like series I, the treatments were not randomized. The effective sprayed area of each plot was approximately 80 x 1,000 feet. Murrayair's fixed-wing aircraft applied a 40-feet swath on each pass with two complete passes on each side of the flag markers. In this test, delivery was either 3 or 6 gallons per acre. The AP-20+ ORANGE (6+12 lb/acre) and AP-20+phytar 560G (6+ 6 lb/acre) treatments were omitted and later included in series III.

On the October 9 spraying, the weather was favorable, however, 1-3 mph easterly trades caused slight mauka drifts. There was also periodic drizzling, becoming heavier after the application of treatment 10. Spraying was discontinued and the remainder of the treatments applied on October 15. Weather was clear but a slight drizzle occurred during the application of treatments 12, 13, and 14. No significant amount of drift was noted. Diurnal temperatures varied between 72 and 82°F during the 2-week period following the initial spraying. There was 0.34 and 0.80 inches of rainfall for the first 4 days following the October 9 and October 15 spraying, respectively. A total of 5.34 inches was received for the period October 10 to November 15.

Visibility and injury ratings were obtained 1, 4, 7, 14, and 30 days following application and on a monthly basis thereafter. The rating system has been previously mentioned. Photographs of pre-tagged woody species and overall plots were also taken on rating days.

Although the delivery volumes of 3 and 6 gallons per acre are quite critical in this test, the spray system on the aircraft was not calibrated. Murrayair's pilot, in this case, has had many years of experience with spray deliveries so that further calibration was not essential. The effect of water and diesel oil diluents on total delivery was not further investigated and was assumed to be similar. This assumption understandably is incorrect, however, other facts such as wind velocity; height of flight, etc. produces greater significant errors.

The problem of foaming was resolved by using a silicone defoamer. In all the tests, complete precautions were taken in handling of chemicals. Each person was required to wear gloves, goggles, respirators, and aprons or coveralls. Aircraft props were cut-off during loading to ensure safety from chemical backwash and carelessness.

TABLE 4: TREATMENT SCHEDULE FOR SERIES II

Treat. No.	Chemical	Rate lb/A	Del. gpa.	Volume in GPA Chemical	Volume in GPA Diluent	Volume Req'd[a] Chemical	Volume Req'd[a] Diluent[b]	Gallons Total
1	Diquat	3	6	1.5	4.5	9	27W	36
2	Diquat	6	6	3.0	3.0	18	18W	36
3	Diquat	9	6	4.5	1.5	27	9W	36
4	PHYTAR 560G	6	6	2	4	12	24W	36
5	PHYTAR	12	6	4	2	24	12W	36
6	PHYTAR	9	3	3	--	18	--	18
7	PHYTAR	15	6	5	1	30	6W	36
8	PCP	6	6	1.5	4.5	9	27d	36
9	PCP	12	3	3	--	18	--	18
10	PCP	12	6	3	3	18	18d	36
11	PCP	18	6	4.5	1.5	27	9d	36
12	Diquat + PHYTAR + 1% L-251	6+6	6	3+2	1	18+12	5.6W[c]	36
13[d]	AP-20	6	3	2	1	20	10d	30
14[d]	AP-20	12	6	4	2			

a/ With 12 gal. spray tank reserve.
b/ W = water, d = diesel oil, L = L-251 .
c/ Include 1.5L (0.4 gals.) L-251.
d/ Treatment 13 and 14 applied as one mixture.

Series III: Rapid Defolient--Systemic Combinations

Treatments were applied on February 24, 1968 by Murrayair, Ltd. There were 14 treatments with 2 replications (Table 5). These were non-randomized. Plots were slightly smaller than the first two series but the actual spray area was approximately 80 x 1,000 feet as compensated by over-flying. The basic spray application was 6 gallons per acre.

Weather during application was exceptionally clear with moderate overcast. Wind direction was variable, generally southeasterly, but very slight and not even registering on a portable anemometer. Temperature varied between 73-77°F and no rainfall occurred during the spray period.

Old rubber tires were used as a source of smoke for precise wind direction observation since systemics were included in this series. In both replications A and B there were very slight uphill drift of no significance as reported by personnel doing the flagging. All excess chemical in the aircraft was collected, transferred to 55-gallon steel drums, and buried at the Kauai Branch Station. Empty containers were also buried. Following completion of the spraying, the tank and spray system of the aircraft was thoroughly rinsed with blue fax and water. The exterior was "hosed down" once.

Diurnal temperatures at Hanahanapuni varied between 60° and 78°F for 2 weeks after application. Only 0.41 inches of rain fell in the area during the 4-day period following application. More than 7.00 inches occurred from February 25 to March 18. The Hanahanapuni area is situated at the foot of the east side of Mt. Waialeale which receives more than 500 inches of rainfall annually.

Visibility and injury ratings were taken 1, 4, 14, and 30 days following application. The 1-week rating was not obtained due to inclement weather. Data are presented only for the first four months after treatment near the end of the contract period. Only Kodacolor-X 3 x 5 inch photographs were made of all tagged species and whole plots during periodic ratings.

Excessive leakage from the 55-gallon stainless steel drum containing AP-20 was apparently due to defective welding on the bottom and sides. This eliminated application of the proposed AP-20 treatment at 6 lb/acre which however, was already included in series II.

During every series application, communication between the spray site and airfield was accomplished by 100 mw walkie-talkies. This system required 1 or 2 intermediate relay stations between points to permit reliable communication. No FCC license is required for using this type of walkie-talkie.

Series IV: Systemics

The 19 treatments scheduled for this series, 13 at Hanahanapuni and 6 at Moalepe, were applied on December 21, 1967 (Tables 6 and 7). These were non-randomized and non-replicated. Murrayair, Ltd. made the applications on 4.5 to 5.0-acre plots. Three 40-foot swathes were sprayed, one pass centered and single passes on both sides of the initial pass, giving an effective

TABLE 5: TREATMENT SCHEDULE FOR SERIES III

Plot No.	Chemical	Rate lb/A	Del. gpa	Volume in GPA Chemical	Volume in GPA Diluent	Volume Req'd Chemical	Volume Req'd Diluent[b]	Gals[a] Total
1	ORANGE (M3151)	12	6	1.5	4.5	7.5	22.5d	30
2	ORANGE + PCP	12+12	6	1.5+3	1.5	7.5+15	7.5d	30
3	ORANGE + DNBP	12+7.5	6	1.5+1.5	3	7.5+7.5	15d	30
4	ORANGE + DNBP	8+12	6	1+2.4	2.6	5+12	13d	30
5	ORANGE + PHYTAR 560G + L-251	12+6	6	1.5+2+2	0.5	7.5+10 +10	2.5W	30
6	PCP + Propanil (QI-99)	6+6	6	1.5	4.5	7.5	22.5d	30
7	PCP + Propanil (QI-99)	12+12	6	3	3	15	15d	30
8	PCP + PHYTAR + L-251 + L-249	6+6	6	--	--	7.5+10 +7.8+4.7	--	30
9	DES-I-CATE	3	6	6	--	30	--	30
10	DES-I-CATE + Paraquat	3+1	6	5.5+0.5	--	27.5+2.5	--	30
11	DES-I-CATE + Paraquat	1+3	6	2+1.5	2.5	10+7.5	12.5W	30
12	DES-I-CATE + ORANGE	2+8	6	4+1	1	20+5	5d	30

Table 5, Cont.

Plot No.	Chemical	Rate lb/A	Del. gpa	Volume in GPA Chemical	Diluent	Volume Req'd Chemical	Diluent[b]	Gals[a] Total
13	AP-20 + ORANGE	6+12	6	2+1.5	2.5	10+7.5	12.5d	30
14	AP-20 + PHYTAR + X-77	6+6	6	2+2+1.2	0.8	10+10+6	4W	30

a/ Based on 5 acres.
b/ d = diesel oil, w = water.

TABLE 6: TREATMENT SCHEDULE FOR SERIES IVH (HANAHANAPUNI)

Treat. No.	Chemical	Rate lb/A	Delivery gpa	Volume in GPA Chemical	Diluent	Volume Req'd[a/] Chemical	Diluent	Gals. Total
1	TORDON 101 (M2628)	1.5+6	3	3	--	18	--	18
2[c/]	TORDON 101 (M2628)	3+12	6	6	--	36	--	36
3	M3142	3	3	0.75	2.25	4.5	13.5d	18
4	M3142	6	3	1.5	1.5	9	9d	18
5	M3142 + Silvex	3+9	3	0.75+2.25	--	4.5+13.5	--	18
6	M3142 + ORANGE	3+18	3	0.75+2.25	--	4.5+13.5	--	18
7	M3140	3+12	3	3	--	18	--	18
8	M3140	4.5+18	6	4.5	1.5	27	9d	36
9	M3140 + Dowco 224	2+16	3	2+1	--	10+5	--	15
10	ORANGE (M3151)	16 a.e.	3	2	1	12	6d	18
11	ORANGE (M3151)	24 a.e.	3	3	--	18	--	18
12	TORDON 22K + ORANGE	4+8	3	2+1	--	12+6	--	18
13	TORDON 22K + Diquat	3+3	3	1.5+1.5	--	9+9	--	18

a/ Based on 6 acres.
b/ d = diesel oil.
c/ Single load and pressure adjusted.

TABLE 7: TREATMENT SCHEDULE FOR SERIES IVM (MOALEPE)

Treat. No.	Chemical	Rate lb/A	Delivery gpa	Volume in GPA Chemical	Volume in GPA Diluent	Volume Req'd[a/] Chemical	Volume Req'd[a/] Diluent[b/]	Gals. Total
14	M3189 (picloram + dalapon)	2+13	3	2	1	12	6d	18
15	M3189	3+19.5	3	3	--	18	--	18
16	M3189	4+26	6	4	2	24	12d	36
17	M3190 (picloram + 2,4,5-T + dalapon	1.5+1.5+10.5	3	2	1	12	6d	18
18	M3190	2 1/4 + 2 1/4 + 15 3/4	3	3	--	18	--	18
19	M3190	3+3+21	6	4	2	24	12d	36

a/ Based on 6 acres.
b/ d = diesel oil.

sprayed width of approximately 120 feet. Total delivery was generally 3 gallons per acre. Six gallons per acre was used in four cases coinciding with higher rates.

Treatments for the Hanahanapuni area were applied in the morning hours. Weather was clear with only slight overcast. Drift was held to a minimum since wind velocity was nil. Temperatures during application were 68°F at 8:00 a.m. rising steadily to 77°F by noon. Weather was quite cool for a couple weeks after application and temperatures remained below 72°F, averaging 65°F. 5.48 inches of rain fell at the Hanahanapuni site during the first week. The area received 15.33 and 8.92 inches of rainfall during the first and second months following application, respectively.

At the Moalepe site, easterly trades were generally slight, but gusts up to 7 mph occurred during the application of treatments 15 and 16. Although heavy drift was noted, the trade wind direction prevented herbicide transport to sensitive crop areas located in the opposite direction of the trades. Temperature was 77°F and no rain fell during application of the 6 plots. The Moalepe area received 9.50 and 6.42 inches of rainfall in the first and second months following application, respectively.

All excess in the aircraft tank and spray system was collected, transferred to steel 55-gallon drums, and buried. Empty containers were also buried immediately following completion of the spraying. The aircraft tank and spray system were rinsed once with diesel fuel which was collected and followed with a thorough washing with blue fax and water. The exterior was also washed.

Visibility and injury ratings were obtained 1, 2, 3, and 4 weeks following application and on a monthly basis thereafter. Colored photographs of tagged woody species and whole plots were also taken at those intervals. Aerial photographs of series IVH were taken on January 25, 1968 about 1 month after treatment.

There was an option to use VISTICK in order to reduce the amount of herbicide drift, however, it was not utilized after several simple tests in the laboratory indicated immiscibility of this substance with diesel fuel.

RESULTS AND DISCUSSION

Series I

The principal woody species found in series I were guava, ohia, melastoma, and lantana. Javaplum, christmasberry, and waiwi occupied less than 10 percent of the total area. The growth habitat of all these woody species varies considerably and they are not uniformly distributed throughout the experimental site. Visibility and injury data for the major part reflects the true effect of the chemicals on each individual specie, however, in some instances,

ratings may not be entirely representative of a species having very low density. Precaution, therefore, must be taken when assessing certain treatments.

Furthermore, the use of a single rating system was questionable regarding the true vegetation response to the chemicals and thus the double visibility (defoliation) and injury (damage) decimal system was utilized. Each datum presented in this report is the average of ratings obtained by several investigators at specified periodic intervals. The visibility and injury data for series I is shown in Table 13 in the Appendix. The period when serious defoliation initially occurs on the major woody species is presented in Table 8.

Paraquat Treatments

No serious defoliation (visibility rating greater than 6.5) of guava, lantana, javaplum and waiwi by paraquat 4.7 and 9.4 lb/acre occurred during the entire 6-month evaluation period. However, serious injury to lantana was observed for the initial 2 weeks after treatment followed by immediate regrowth. Javaplum showed extensive injury (mainly chlorosis) at 3 months, but defoliation remained slight. Both paraquat rates had no significant injurious effect on guava, hala, and waiwi. Hala and silveroak evaluations are reported to provide additional information.

Melastoma was severely affected by paraquat during the initial stages of the 6-month evaluation period. This was evident as this specie possessed complete vegetative canopy prior to treatment. Infestation of the foliage by the insect Selca brunella became quite serious approximately 2 months after treatment and completely masked the true effect of the chemicals. The lasting injurious effect, therefore, is apparently due to a combination of biological and chemical control. No further discussion concerning the chemical effects of melastoma will be made for all the series although data is presented.

Ohia was seriously defoliated 2 months after treatment at both paraquat rates. The defoliating effect is depicted in photos 3a and 3b. The response by ohia to paraquat is immediate and gradually reaches its peak defoliation by the second month. The duration of serious defoliation is not lengthy, however, and refoliation occurs after the fourth month. Refoliation sets in about a month earlier at the lower paraquat rate.

Christmasberry is a sensitive woody species and reaches the serious defoliation stage by the second week after paraquat treatment. Photo 4a shows the almost complete defoliation of this specie at 2 weeks by paraquat 9.4 lb/acre. Photo 4b shows the appreciable refoliation that occurred at 3 months although extensive resprouting can be seen by the second month. Insufficient data was obtained for the effect of 4.7 lb/acre paraquat on christmasberry but the effect apparently would be similar to paraquat at 9.4 lb/acre with an even earlier refoliation period.

The effect of paraquat 9.4 lb/acre on the defoliation period of several woody species is shown in Figure 1. Considerable differences in response to paraquat

TABLE 8: SERIES I, RAPID DEFOLIATION
PERIOD WHEN SERIOUS DEFOLIATION OCCURS
(VISIBILITY RATING 6.5) ON SEVERAL WOODY SPECIES *

Chemical lb/acre	Guava	Lantana	Ohia	Java Plum	Christmas-berry	Waiwi	Silver Oak
Paraquat 4.7	n	n	2m	n	--	n	2w
Paraquat 9.4	n	n	2m	n	2w	n	--
Diquat 6	n	1w	n	1w	1m	n	n
Diquat 12	1m	n	2m	2w	1m	n	n
PCP 12	n	n	n	n	2w	n	n
PCP 24	n	n	n	n	1w	n	n
PCP 40	n	n	n	n	1w	n	n
PHYTAR 6	n	2w	n	n	--	--	--
PHYTAR 12	n	1w	n	n	1w	n	n
PHYTAR 18	n	1w	n	n	--	n	--
Silvex 7	(?)3m	n	n	(?)2m	2m	(?) 2m	--
Silvex 14	2m	1m	n	2m	2m	(?) 2m	--
HCA-2,4, 5-T (6+6)	2m	1m	n	2m	(?)2m	2m	--
HCA-2,4 5-T (12+12)	2m	1m	5m	2m	2m	1m	(?)2m

* n = none, d = days, w = weeks, m = months
(?) = approximate period

Photo 3a: Ohia 1 week after Paraquat 4.7 lb/acre treatment.

Photo 3b: Ohia 2 months after paraquat 4.7 lb/acre treatment.

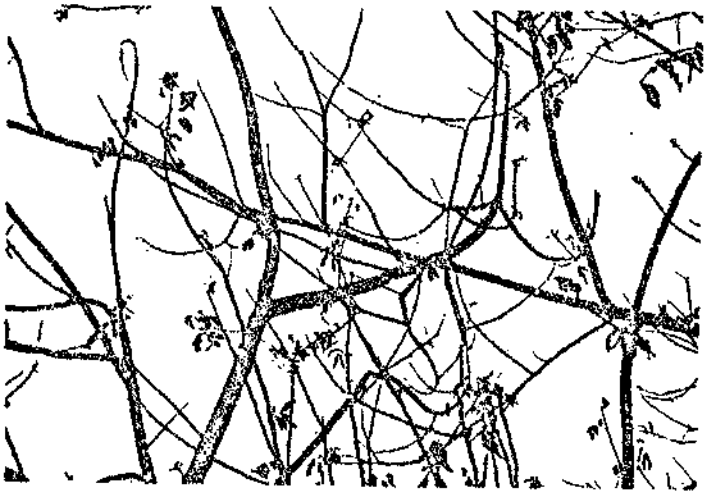

Photo 4a: Christmasberry 2 weeks after Paraquat 9.4 lb/acre treatment.

Photo 4b: Christmasberry 3 months after paraquat 9.4 lb/acre treatment.

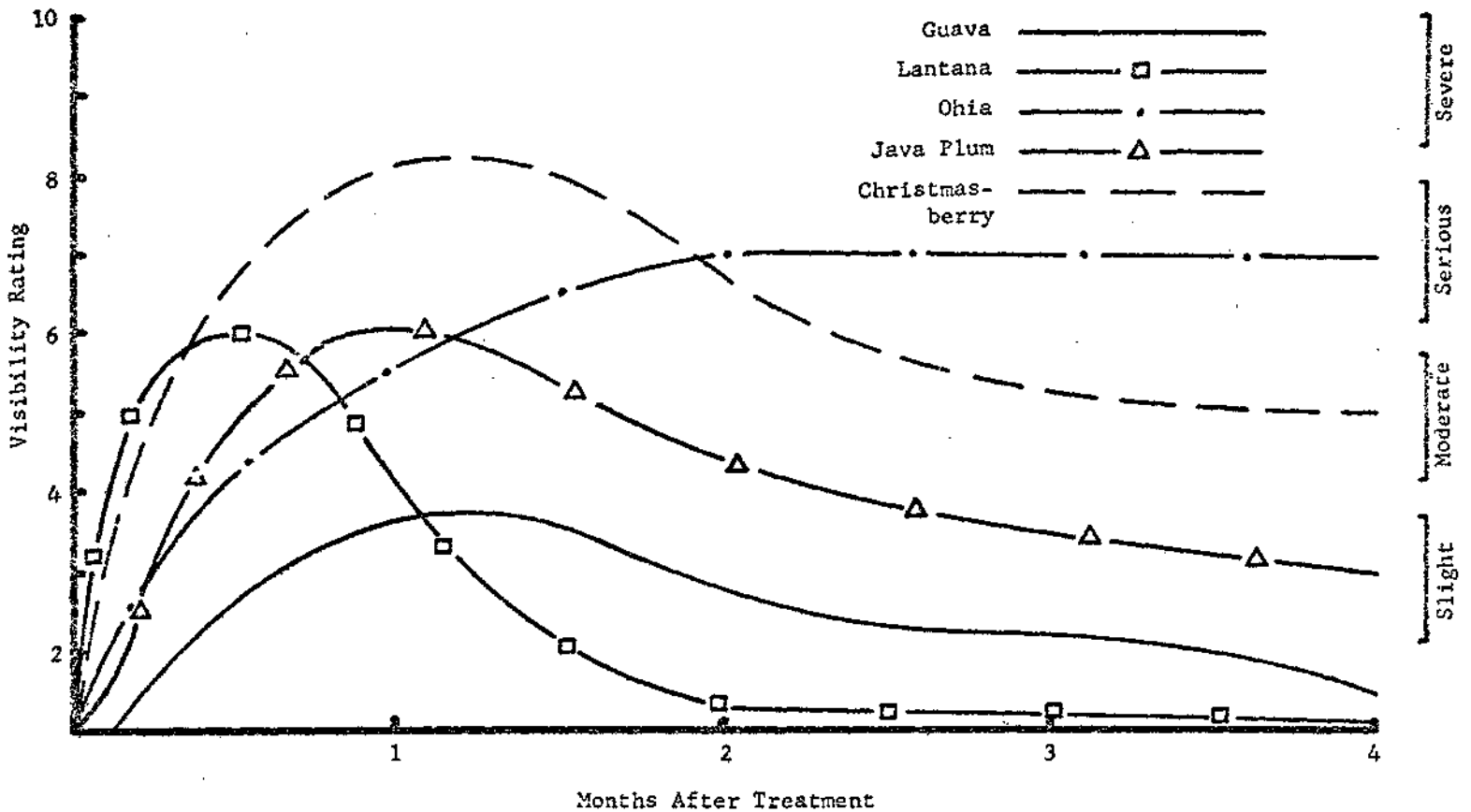

FIG. 1: EFFECT OF PARAQUAT 9.4 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

can be seen for these species. Probably none of these species show both immediate and prolonged defoliation of a serious nature.

Diquat Treatments

Waiwi, hala, and silveroak were not significantly affected by diquat at 6 and 12 lb/acre.

With reference to Table 8, the effect of diquat rates on several species is ambiguous. Lantana did not reach a stage of serious defoliation by diquat 12 lb/acre treatment and javaplum data showed that this species reached the serious stage a week later than the lower rate. The foliage response of javaplum to the higher rate of diquat is shown in photos 5a and 5b. Serious defoliation occurs at 2 weeks and almost complete refoliation is observed by the second month. Of interest is the rapidity with which javaplum recovers from the effects of a rapid defoliant.

Diquat 12 lb/acre was also effective in causing serious defoliation of guava and ohia at 1 and 2 months, respectively. Photographs of guava taken periodically indicated that the most significant change in foliation occurs following the initial week. The amount of leaf drop increases gradually and reaches its maximum 1 month after treatment. Resprouting is immediately evident and has quite progressed by the second month. Defoliation of guava by diquat 6 lb/acre was not of a serious nature.

A distinct and gradual increase in defoliation of ohia was observed, reaching its peak by the second month. Often it is difficult to determine the extent of ohia defoliation since many branchlets remaining after leaf drop may not permit maximum visibility. In evaluating this specie, therefore, the remaining foliage areas were taken into consideration with limited emphasis on denuded branchlets. New sprouts gradually appear on branches and branchlets after 2 months.

Christmasberry was seriously defoliated 1 month after diquat treatment regardless of rate. At 2 months, new sprouts appeared and visibility was slight by the third month.

Diquat generally was slightly superior to paraquat from the standpoint of rapidity and duration of defoliation. Diquat was more effective on guava and javaplum than paraquat.

Pentachlorophenol Treatments

Pentachlorophenol was applied at 12, 24, and 40 lb/acre as a mixture with water. These components were not miscible and, therefore, did not mix properly.

Guava, lantana, ohia, javaplum, waiwi, and silveroak were not seriously defoliated by any of the PCP treatments (Table 8). Only christmasberry showed some response at 2 weeks. Regrowth was rapid and this specie had regained full foliage by the second month.

Photo 5a: Javaplum 2 weeks after Diquat 12 lb/acre treatment.

Photo 5b: Javaplum 2 months after Diquat 12 lb/acre treatment.

The effect of PCP treatments in defoliating some of the principal woody species appeared superior in series II.

PHYTAR 560G Treatments

Only lantana and christmasberry showed serious defoliation (visibility rating more than 6.5). PHYTAR 12 and 18 lb/acre produced serious lantana defoliation within 1 week but had refoliated almost completely by the 1 month period.

Guava, ohia, javaplum, and waiwi did not show any serious effect from PHYTAR treatments.

A stand of hau in the PHYTAR 12 lb/acre plot was seriously defoliated within a week but almost completely recovered at 2 months. This specie occupies considerable area along valley bottoms and is a noxious woody plant due to its rapid entangling growth and formation of very dense stands.

Silvex Treatments

Silvex was substituted for DNBP in series I when Murrayair Ltd. refused to apply the latter. Although silvex is a systemic herbicide and not a rapid defoliant, it was incorporated in this test to evaluate its rapidity of action and durative effects on some of the Hawaiian woody species. Silvex was also closely compared with HCA-2, 4, 5-T.

The silvex was applied at 7 and 14 lbs/acre as a water mixture.

Guava, javaplum, christmasberry, and waiwi were seriously defoliated 2 months after silvex application regardless of rate. Photos 6a and 6b depict the degree of guava defoliation by silvex 14 lb/acre at 1 week and 2 month periods, respectively. Regrowth appeared at about 4 months and was one-half refoliated by 6 months.

The defoliation period of some woody species is shown in Figure 2. Although lantana showed serious defoliation 1 month after silvex 14 lb/acre treatment, it had completely refoliated by the second month indicating a very short effective duration even for a systemic-type herbicide. On the contrary, javaplum and christmasberry remained seriously defoliated from the 2 to 4 month period. Some regrowth appeared on both species at 4 months but defoliation was still serious even at 6 months following treatment.

Ohia did not respond in similar fashion to an earlier test in which it was completely denuded by two applications of silvex at 4 lb/acre each application (Motooka et al, 1967). It was anticipated that in the recent test, silvex would be more effective on ohia than the observed moderate defoliation. However, defoliation was not of a serious nature throughout the 7-month rating period.

Silvex 9 lb/acre was also included in serious IVH in combination with 3 lb/acre of picloram ester.

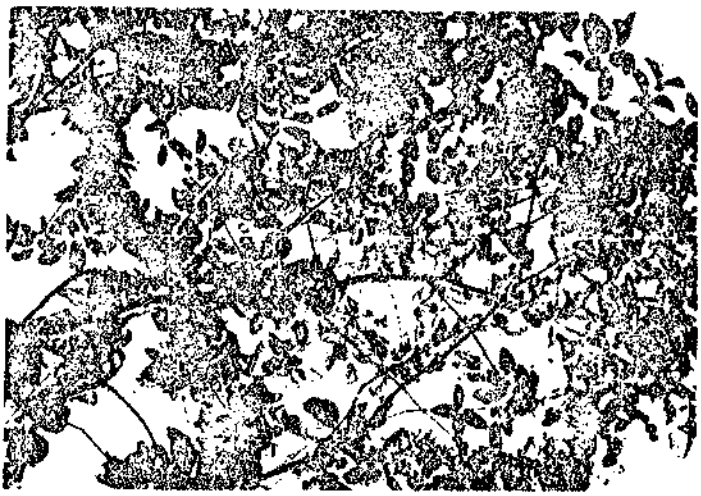

Photo 6a: Guava 1 week after Silvex 14 lb/acre treatment.

Photo 6b: Guava 2 months after Silvex 14 lb/acre treatment.

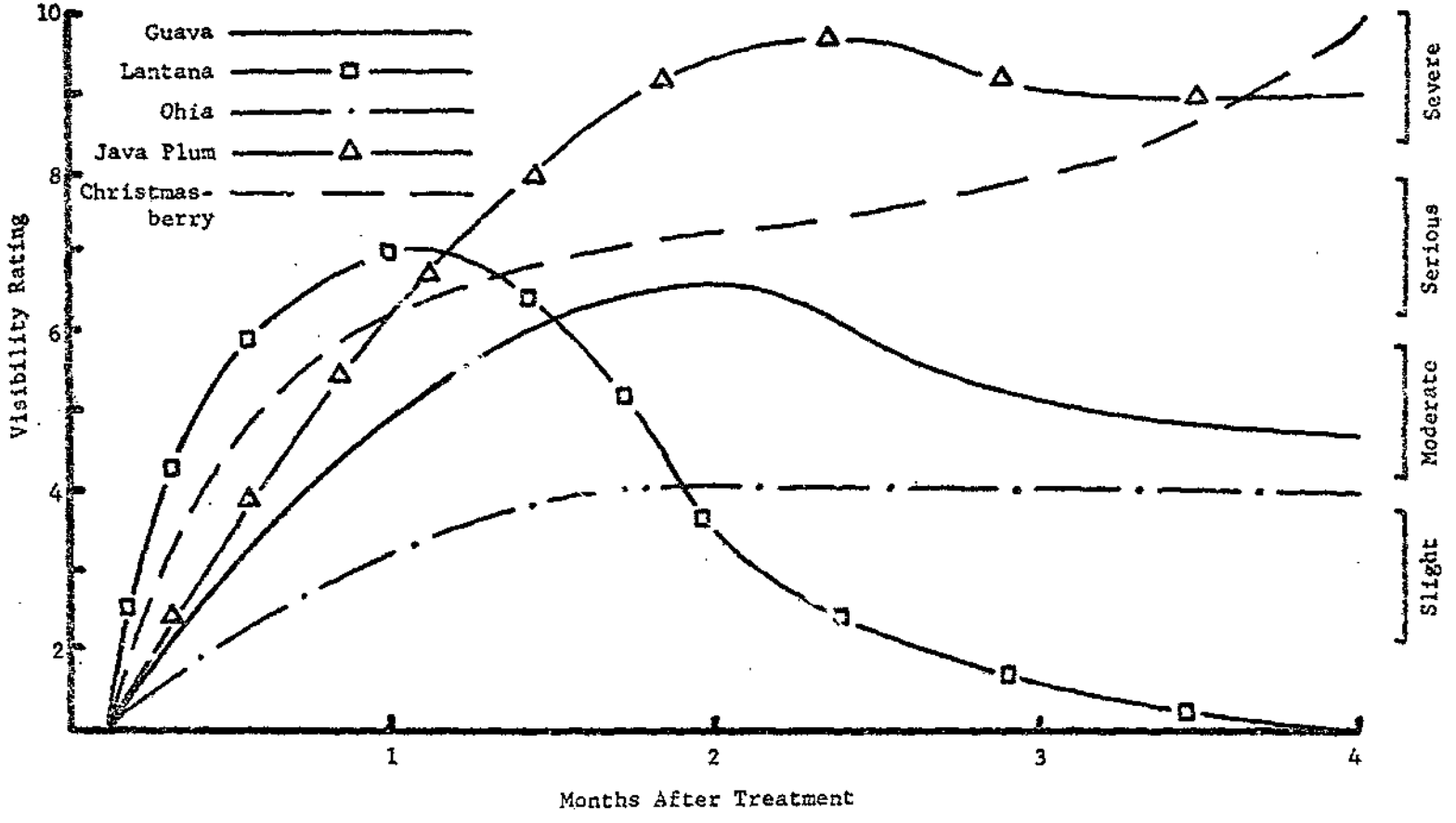

FIG. 2: EFFECT OF SILVEX 14 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

Hexachloroacetone-2, 4, 5-T Treatments

The defoliating effects of HCA-2, 4, 5-T were similar to silvex. Guava, javaplum, christmasberry, waiwi, and silveroak were seriously defoliated by the 2 month rating period (Table 8). In the early stages, HCA-2, 4, 5-T is relatively ineffective against these woody species.

The regrowth on guava is not very significant until 4 and 6 months after treatment with HCA-2, 4, 5-T combinations of 6 + 6 and 12 + 12 lb/acre, respectively. The refoliation process on guava is gradual. Javaplum did not show any appreciable resprouting even after 7 months. This woody species showed severe defoliation between the 2- and 7-month periods at both rates. Some scattered trees of guava and javaplum are almost completely killed.

Christmasberry appeared to be completely killed between the 2 and 6 month periods. Regrowth is questionable and it may be months before complete refoliation is attained, if not killed. Waiwi, on the contrary, was almost completely denuded 5 months after treatment but showed considerable regrowth and recovery thereafter. Photos 7a and 7b shows the degree of waiwi defoliation 1 week and 1 month after the 12 + 12 lb/acre treatment.

Defoliation of lantana was serious at 1 month but had completely refoliated by the second month. A longer duration of defoliation was anticipated from lantana treated with either silvex or HCA-2, 4, 5-T. The rapid recovery rate of this specie is perhaps due to poor translocation or detoxification of the chemical within the plant.

The effect of HCA-2, 4, 5-T on ohia was similar to that observed from silvex treatment. The defoliating process is gradual and maximum visibility is questionably attained approximately 5 months after the 12 + 12 lb/acre treatment. The 6 + 6 lb/acre rate of HCA-2, 4, 5-T and both rates of silvex did not produce any serious defoliation on ohia throughout the rating period. Photographs obtained at 6 months show considerable regrowth on ohia.

The periodic defoliating effect of 12 + 12 lb/acre of HCA-2, 4, 5-T on several woody species is shown in Figure 3.

Resume'

Paraquat and diquat were temporarily effective on ohia and christmasberry defoliation. Serious defoliation of javaplum was observed following diquat treatment but almost complete refoliation occurs by the second month. The other principal woody species were generally unaffected.

Pentachlorophenol and PHYTAR 560G treatments were generally ineffective in causing serious defoliation of the major species.

The systemic herbicides included in this test, silvex and HCA-2, 4, 5-T, produced significant responses by guava, javaplum, christmasberry, and waiwi. These species were seriously defoliated 2 months after treatment with both treatments. Regrowth generally is evident after 4 months. The effect on ohia was ambiguous and inconclusive.

Photo 7a: Waiwi 1 week after Hexachloroacetone-2, 4, 5-T 12 + 12 lb/acre treatment.

Photo 7b: Waiwi 1 month after Hexachloroacetone-2, 4, 5-T 12 + 12 lb/acre treatment.

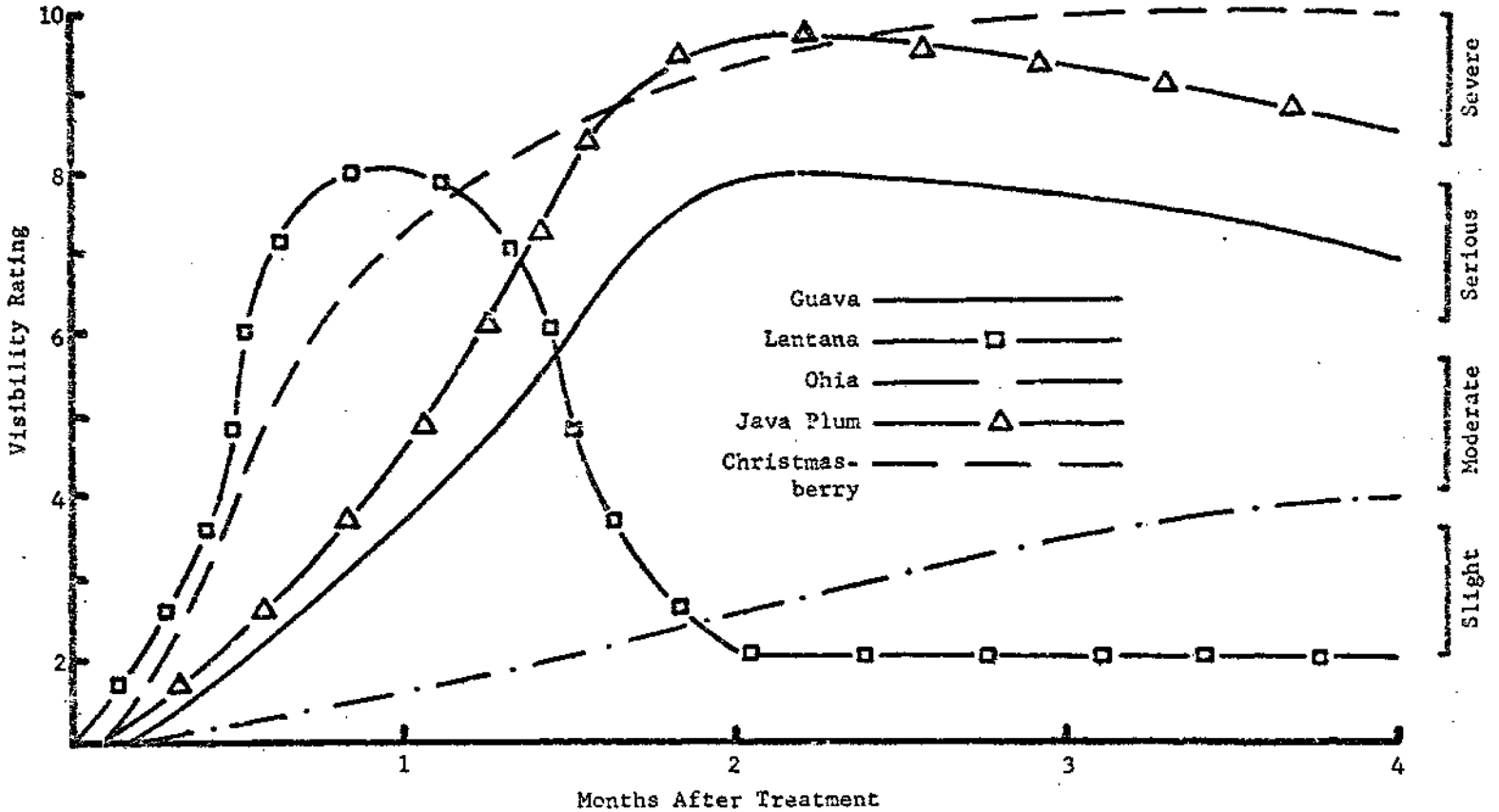

FIG. 3: EFFECT OF HEXACHLOROACETONE-2,4,5-T 12 + 12 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

Series II

The predominating woody species found in this series were similar to that of series I. Of additional importance is the presence of rhodomyrtus (Rhodomyrtus tomentosa) which comprises 13% of the total area of series IIB. Initially introduced as an ornamental, it has now reached serious proportions forming scattered but dense stands on considerable areas of Kauai.

The considered aspects of this test were the effects of rates and volumes of rapid defoliants on the major woody species. Water was generally used as a diluent for diquat and PHYTAR 560G treatments, and diesel oil for pentachlorophenol and AP-20 treatments. L-251 surfactant at 1% (v/v) was included with the diquat + PHYTAR combination.

Visibility and injury ratings obtained over a 4-month observation period are presented in Table 14 of the Appendix. Table 9 shows the initial period of serious defoliation (Visibility rating > 6.5) on several woody species.

Diquat Treatments

Diquat was applied at 3, 6, and 9 lb/acre at a total delivery of 6 gallons per acre.

All rates of diquat produced serious defoliation of lantana, javaplum, and christmasberry. The response by lantana was immediate and produced serious visibility within 2 weeks. The duration of this defoliation, however, was significant only until 6 weeks after treatment and resprouting progressed rapidly thereafter.

Diquat at 6 and 9 lb/acre had seriously defoliated javaplum by the second week. The lowest rate took another 2 weeks to reach that stage. Regrowth was evident 3 months after treatment and almost completely refoliated at 4 months regardless of rate. A comparison of the defoliation stages of javaplum 2 weeks after separate diquat 6 and PHYTAR 6 lb/acre treatments are shown in photos 8a and 8b, respectively. This indicates the greater rapidity of action of diquat as compared to PHYTAR.

Christmasberry was seriously defoliated within the first week. Although slight sprouting was evident at the 1 month period, visibility was still high at the second month and then refoliated rapidly thereafter regardless of rate.

Figure 4 shows the defoliation effect of diquat 9 lb/acre on some woody species throughout the 4 month period. As mentioned earlier, the response by all species is fairly rapid with short duration of effectiveness.

Guava defoliation was serious only at the 9 lb/acre rate of diquat. Maximum visibility occurred at 2 months but this specie had completely recovered by the fourth month. The 6 lb/acre rate of diquat applied in series I was also consistent with the guava response obtained here. Diquat at 12 lb/acre incorporated in the earlier test produced serious guava defoliation by the first month, similar to that reflected by diquat 9 lb/acre in this test.

TABLE 9: SERIES II, RAPID DEFOLIANTS
PERIOD WHEN SERIOUS DEFOLIATION OCCURS
(VISIBILITY RATING > 6.5) ON SEVERAL WOODY SPECIES*

Chemical lb/acre	Guava	Lantana	Ohia	Java Plum	Christmas-berry	Waiwi	Silver Oak
Diquat 3	n	2w	1m	1m	1w	n	n
Diquat 6	n	2w	n	2w	1w	n	n
Diquat 9	1m	2w	2w	2w	1w	n	n
Diquat+PHYTAR 6+6	1w	1w	1m	1m	4d	n	2w
PHYTAR 6	1m	1w	n	n	1w	n	n
PHYTAR 9	2m	4d	n	n	1w	n	n
PHYTAR 12	1m	4d	n	n	1w	n	n
PHYTAR 15	2m	4d	n	n	1w	n	2w
PCP 6	1m	4d	n	n	1w	n	1m
PCP 12L	2m	4d	n	n	1w	n	n
PCP 12H	1w	1w	n	1m	1d	1m	n
PCP 18	1w	1w	1m	2m	1d	1m	1m
AP-20 6	n	n	n	n	n	n	n
AP-20 12	n	n	n	n	4d	n	n

* n = none, d = days, w = weeks, m = months

Photo 8a: Javaplum 2 weeks after Diquat 6 lb/acre treatment.

Photo 8b: Javaplum 2 weeks after PHYTAR 6 lb/acre treatment.

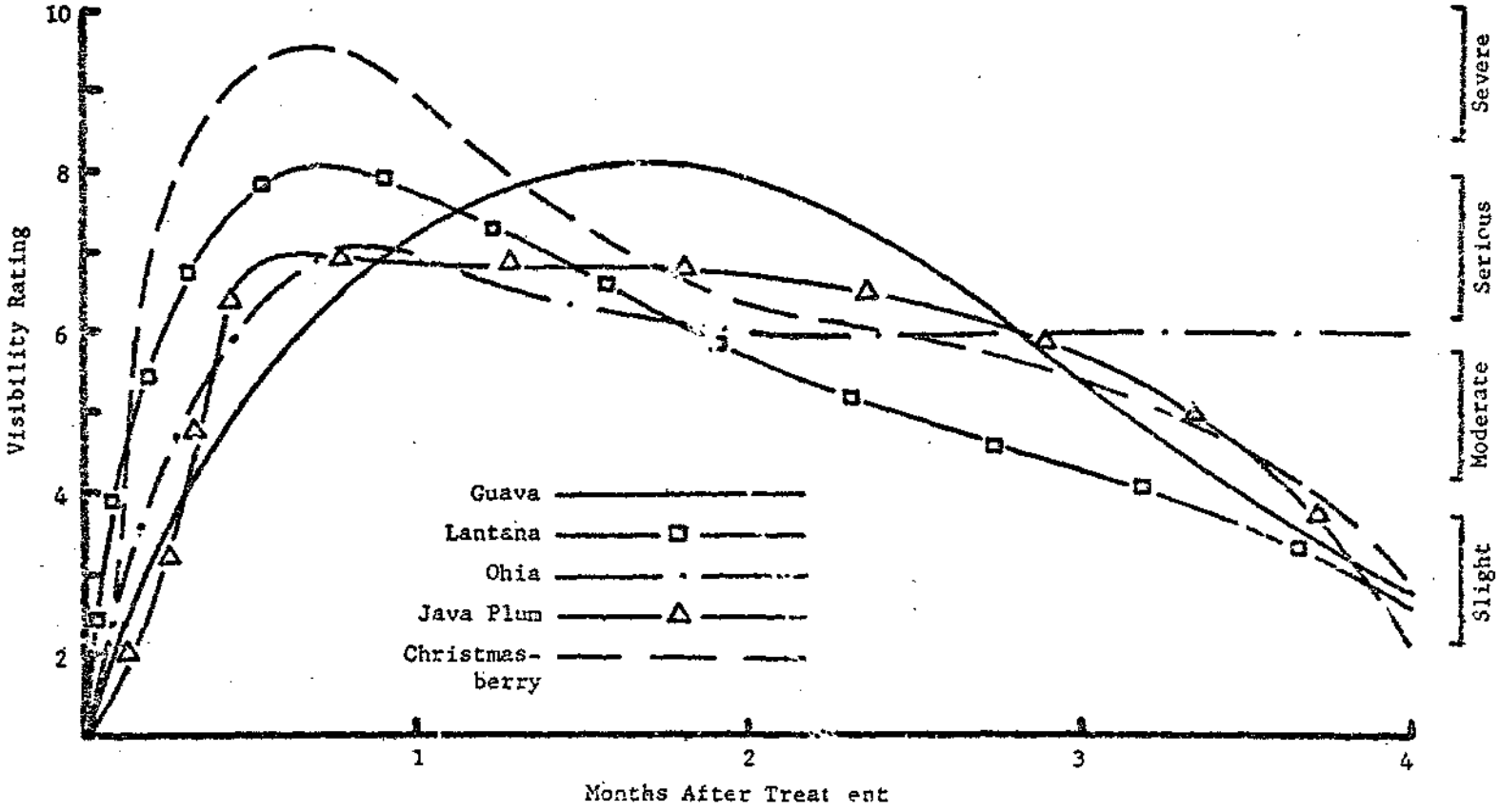

FIG. 4: EFFECT OF DIQUAT 9 LB/. CRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

The diquat 9 lb/acre treatment produced serious ohia defoliation by the second week. It was still effective even after 4 months. The lower rates probably lag approximately 2 weeks before the serious defoliation stage is attained. However, in series I, ohia took 2 months before reaching serious defoliation when treated with 12 lb/acre of diquat. Both 6 lb/acre applications of diquat in series I and II produced only moderate defoliation suggesting that rate as well as season may be critical factors against this specie. The results obtained for diquat 3 lb/acre on ohia may therefore have limited applicability.

No significant response by waiwi, hala, silveroak, and rhodomyrtus from diquat applications were observed.

The combination of diquat + PHYTAR at 6 + 6 lb/acre apparently was one of the better treatments in this test. The inclusion of a surfactant, L-251, may have been a factor in promoting the rapid defoliation of some of the woody species, especially guava and christmasberry.

Figure 5 shows that at the 2 month period, all the principal woody species were seriously defoliated by the diquat + PHYTAR treatment. The effectiveness on javaplum, christmasberry, guava, and lantana tapered off significantly by the fourth month. Ohia was still seriously defoliated by the end of the 4 month period.

In comparing the diquat + PHYTAR treatment with 12 lb/acre of PHYTAR alone, there are several points of interests to consider. First, although the rate of defoliation on guava is more rapid with the combination than with PHYTAR alone, regrowth occurs sooner with the former as depicted by photos 9a and 9b. However, almost complete recovery of guava is observed at the 4 month period regardless of treatment. A similar type of response prevailed with christmasberry.

Secondly, PHYTAR 12 lb/acre alone produced only a moderate defoliative effect on ohia and javaplum as did the other PHYTAR treatments, but the diquat and PHYTAR combination seriously defoliated these species by the first month. If application of this combination is made in areas predominantly ohia and javaplum species, the PHYTAR component apparently does not contribute greatly to the combined performance.

Thirdly, the addition of L-251 surfactant apparently promoted the rapidity of action and effectiveness of the combination on guava, lantana, and christmasberry.

PHYTAR Treatments

PHYTAR 560G was applied at 6, 9, 12, and 15 lb/acre. The 9 lb/acre rate was applied at 3 gallon per acre (low-volume) and the others at 6 gallons per acre (high-volume).

All PHYTAR rates were ineffective in seriously defoliating ohia, javaplum, waiwi, silveroak, and rhodomyrtus. These woody species, however, were

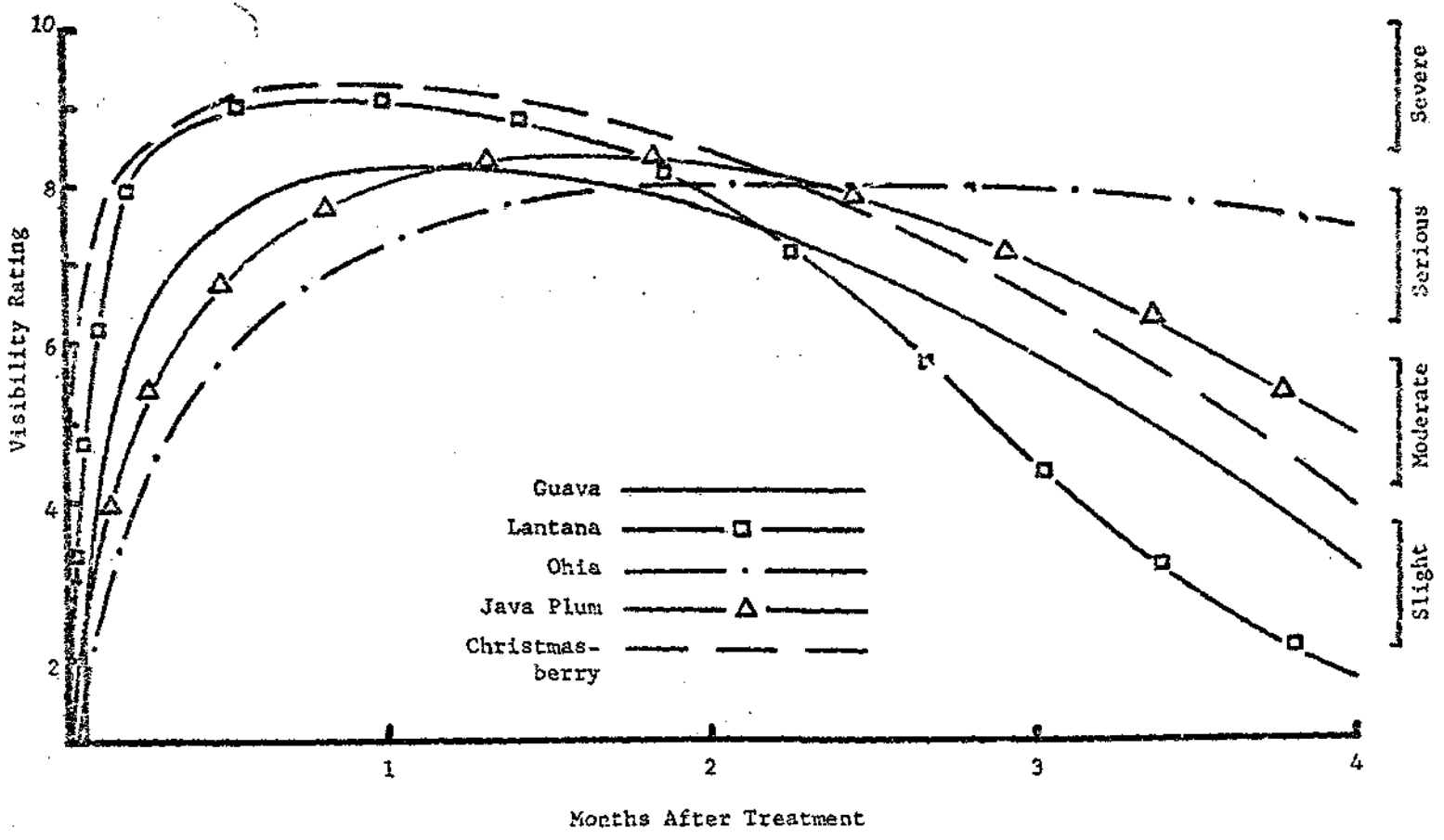

FIG. 5: EFFECT OF DIQUAT + PHYTAR 6 + 6 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

Photo 9a: Regrowth on guava 2 months after Diquat + PHYTAR 6 + 6 lb/acre treatment.

Photo 9b: No regrowth on guava 2 months after PHYTAR 12 lb/acre treatment.

injured to a certain extent and rapidly recovered. This was consistent with results obtained in series I for these species (excluding rhodomyrtus).

Guava, lantana, and christmasberry were significantly affected by all rates. The periodic defoliative effects by PHYTAR 15 lb/acre on these species are shown in Figure 6. At PHYTAR 15 lb/acre guava defoliation was serious by the second month but this stage could have been reached as early as 5 to 6 weeks after treatment. Guava was seriously defoliated at the 1 month period with the PHYTAR 6 and 12 lb/acre treatments, which suggests a faster defoliation effect from PHYTAR 15 lb/acre. Regrowth is generally evident by the third month. The low-volume 9 lb/acre treatment apparently acted at a slower rate on guava but this was inconclusive.

Lantana is rapidly defoliated by PHYTAR. It is seriously defoliated within 4 days to a week and stays significantly defoliated up to 2 or 3 months. The durative effect of PHYTAR on lantana is slightly superior to that of diquat. Photo 10a depicts the rapid defoliation of lantana 4 days following PHYTAR 15 lb/acre treatment and photo 10b shows the effective duration of this treatment although regrowth has occurred.

Christmasberry was almost completely defoliated in 7 days regardless of the rate or volume. New sprouts appear between 1 and 2 months and had completely recovered by the 4 month period.

It might be added here that no definite differences due to rate or volume were found. PHYTAR, regardless of these factors, produced almost similar effects on the major species. Only on guava was the initial period of serious defoliation dubious.

Pentachlorophenol Treatments

To recapitulate, PCP was applied at 6, 12, and 18 lb/acre. The 12 lb/acre rate consisted of both low (3 gpa) and high (6 gpa) volume. Diesel oil was used as a diluent when required.

The performance of PCP in this test was far superior and the effects more pronounced than that observed in series I. The information gathered in this test was definitely more conclusive.

All the major species encountered were seriously defoliated by PCP depending on the rate of application. The low or high volume gallonage was also a critical factor for the effective response of these species to PCP.

The defoliative effect of PCP is fairly rapid. Christmasberry was seriously defoliated only a day after PCP 12H (high lb/acre-volume) and PCP 18 lb/acre application. At the 6 and 12L (low lb/acre-volume) rate, this specie reached the serious defoliation stage at 1 week. It must be emphasized, however, that PCP 12H was applied about a week later than PCP 12L and post-application weather conditions may have influenced or promoted these differences. Regrowth is quite evident at 2 months and almost completely refoliated at 4 months regardless of rate or volume.

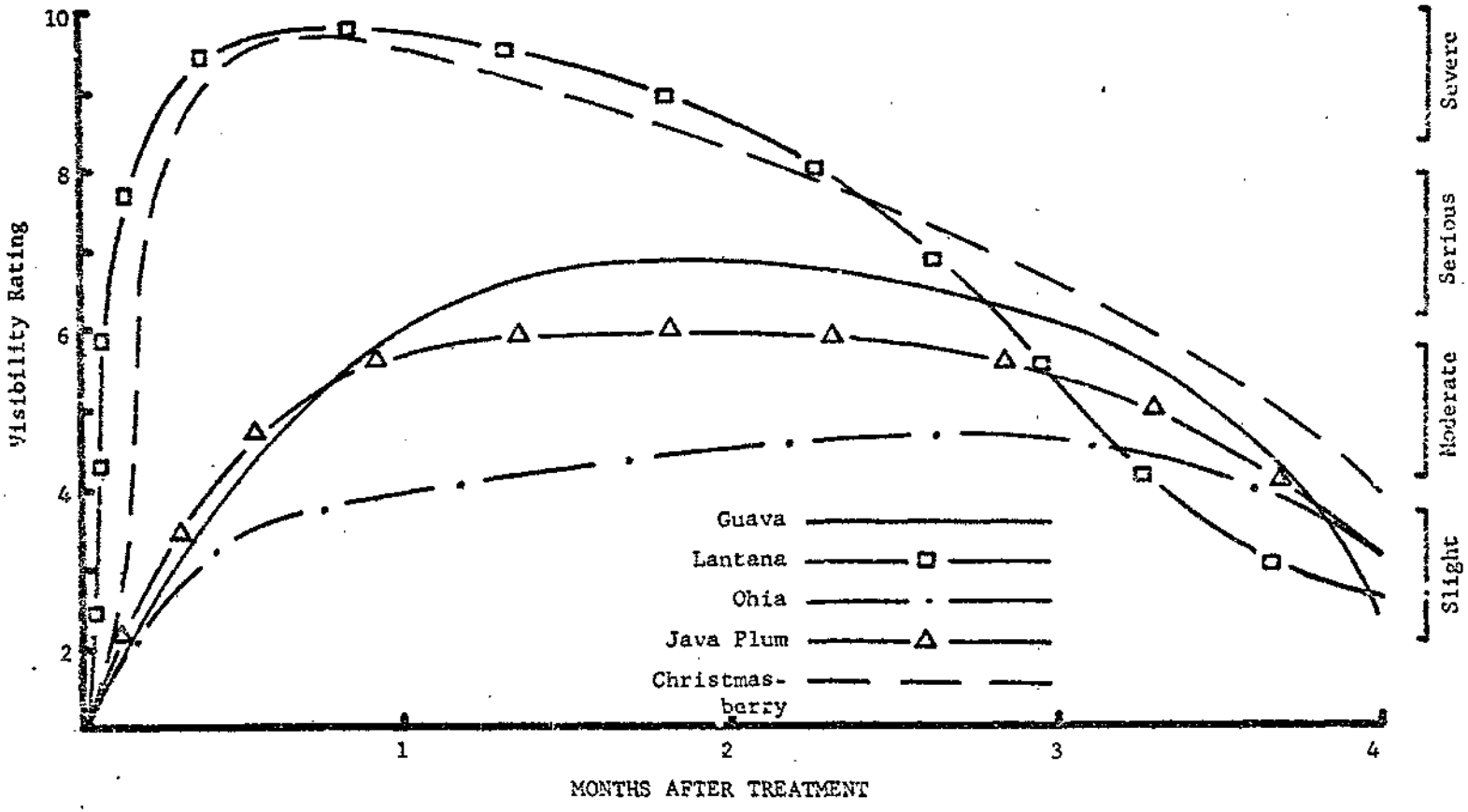

FIG. 6: EFFECT OF PHYTAR 15 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

Photo 10a: Lantana 4 days after PHYTAR 15 lb/acre treatment.

Photo 10b: Lantana 3 months after PHYTAR 15 lb/acre treatment. Note regrowth.

Figure 7 shows the effect of PCP 18 lb/acre on the defoliation period of some woody species. This rate was effective on most species (Table 9). It is of interest that even a hardier woody specie like ohia was seriously defoliated at 1 month with no appreciable regrowth until 4 months after treatment. Most of the species had refoliated considerably by the fourth month. The defoliation of rhodomyrtus is only to a slight extent although at PCP 18 lb/acre injury to this species is moderate and temporary.

A comparison of the defoliation effect on guava after PCP 12L and PCP 12H treatment indicates a faster action by the latter. Photos 11a and 11b presents this comparison at the 1 month period. Regrowth has already started to appear on guava treated with PCP 12H, while approximately 50% of the foliage is still intact with the PCP 12L treatment. The latter treatment produced serious defoliation at 2 months.

The effect on javaplum, like ohia, depended on the PCP rate. No serious defoliation occurred at the 6 lb/acre rate, while this state was achieved at the 12H and 18 lb/acre rate. The differences in javaplum defoliation between PCP 12L and PCP 12H apparently was due to the better foliar coverage obtained by the higher gallonage.

AP-20 Treatments

None of the principal woody species except christmasberry was significantly defoliated by AP-20 treatments. The 12 lb/acre rate caused moderate injury to guava and javaplum but these species eventually recovered without reaching a stage of serious defoliation. Christmasberry was completely defoliated between 4 and 7 days, retained almost complete visibility for 2 months, and then gradually refoliated.

AP-20 was also included in combinations with ORANGE (M3151) and PHYTAR 560G in series III.

Resume'

The more effective treatments in this test were diquat 9, PCP 18, and diquat + PHYTAR 6 + 6 lb/acre. These rapid defoliants caused more pronounced visibility and injury effects on most of the principal woody species than the other treatments. All PHYTAR treatments were ineffective on ohia, javaplum, and waiwi species. AP-20 did not cause any significant defoliative changes on any woody species except christmasberry.

None of the treatments were effective in keeping maximum visibility 4 months after application.

For Pentachlorophenol rates and volumes of application were critical factors on the type of species affected, rapidity of chemical action, and duration of defoliation.

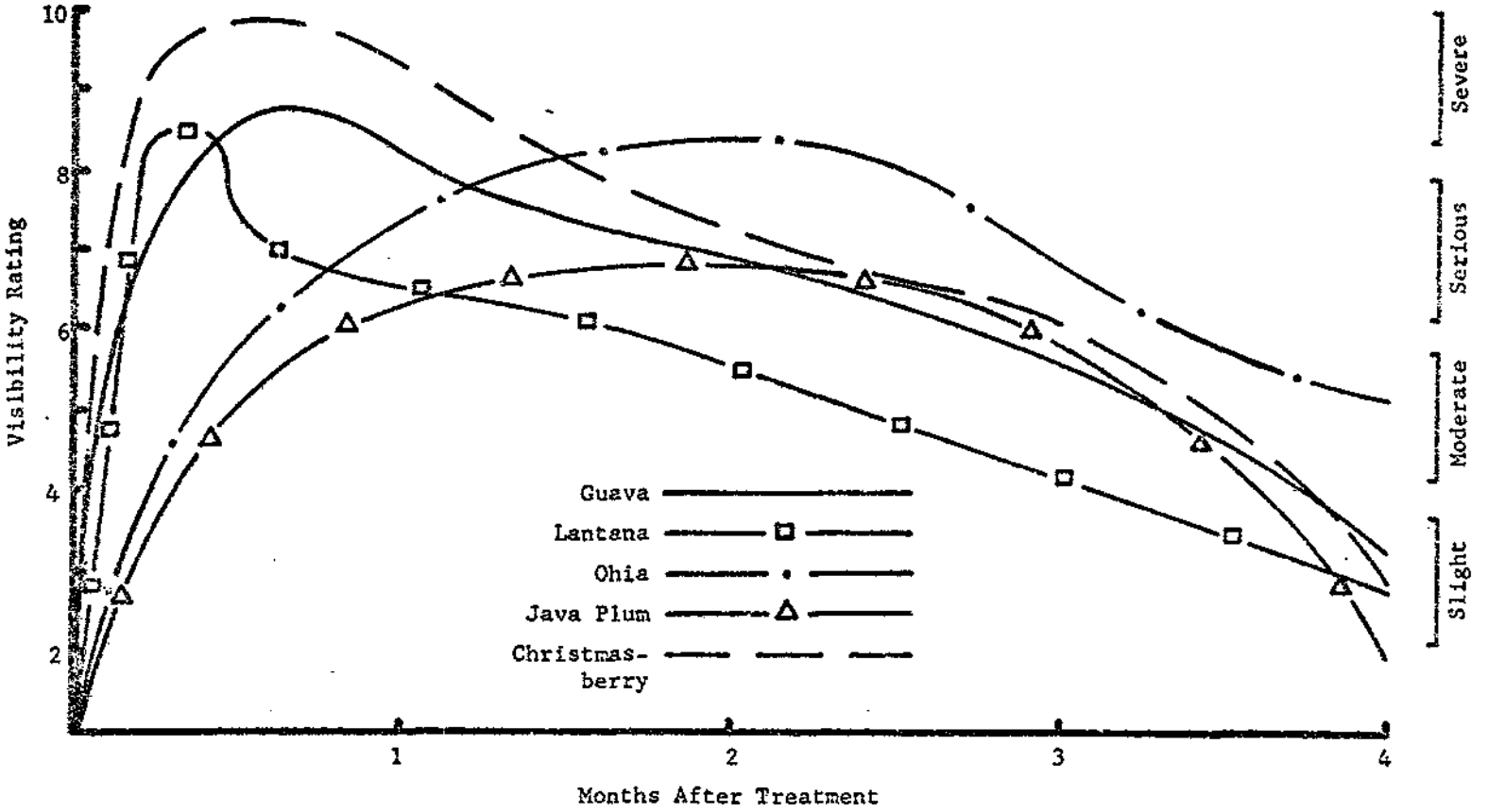

FIG. 7: EFFECT OF PENTACHLOROPHENOL 18 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

Photo 11a: Guava 1 month after PCP 12L (12 lb/acre, 3 gpa) treatment.

Photo 11b: Guava 1 month after PCP 12H (lb/acre, 6 gpa) treatment.

Series III

The objective of this series was to investigate the rapidity of action and the durative effects of rapid defoliant-systemic herbicide combinations on some of the major Hawaiian jungle species.

The test area was located about 5 miles distant from series I and II at Hanahanapuni at the foot of Mt. Waialeale, where the annual rainfall is exceedingly high (Photo 2). The vegetation in this area is primarily ohia and staghorn fern which cover approximately 80% of the area (Table 1). Less prominent woody species are guava, melastoma, lantana, alea, and ohia-ha.

Inclement weather conditions prevented the earlier installation of this test series. Treatments were finally applied on February 24, 1968, by Murrayair, Ltd. The chemicals and their combinations were applied at 6 gallons per acre' total delivery using water or diesel oil as diluents whenever required.

Visibility and injury are reported for a 4 month period following application as shown in Table 15 of the Appendix. The progressive effect of treatment with time is shown in Figures 8 to 14.

ORANGE (M3151)--Rapid Defoliant Treatment

ORANGE (M3151) is a 50:50 mixture of the n-butyl esters of 2, 4-D and 2, 4, 5-T. Applications of ORANGE made alone or in combination with PCP, DNBP, PHYTAR, and AP-20 are rather inconclusive at 1 month. None of these treatments caused serious defoliation (visibility rating >6.5) of ohia, the major woody species, during the first month (Table 10). The more susceptible species like lantana, guava, kalia, and melastoma were seriously defoliated and injured 1 month following treatment. Some regrowth of these succulent species is evident after 1 month, but is not serious even at 4 months.

Photos 12a and 12b show a comparison of the defoliation extent, primarily ohia, two weeks following the application of ORANGE + DNBP (12 + 7.5 lb/acre) and ORANGE + AP-20 (12 + 6 lb/acre), respectively. It is apparent that the DNBP combination caused greater defoliation. Rapid desiccation of foliage is evident when DNBP is applied but serious visibility is not attained until abscission has come into play.

ORANGE applied alone at 12 lb/acre a.e. performed remarkably well on most of the woody species by the first month. Some regrowth on lantana was observed at the 1-month rating period, but is low order even at 4 months.

Staghorn fern was severely injured in 2 weeks and presently constitutes a fire hazard. While staghorn visibility ratings remain low the overall visibility increases as a result of settling and shrinking from about 8 feet in height to less than 1 foot in 4 months.

PCP--Propanil (CI-99) Treatments

At the end of one month no serious defoliation of ohia and ohia-ha by CI-99 had occurred although desiccation was quite pronounced. The rapid injurious

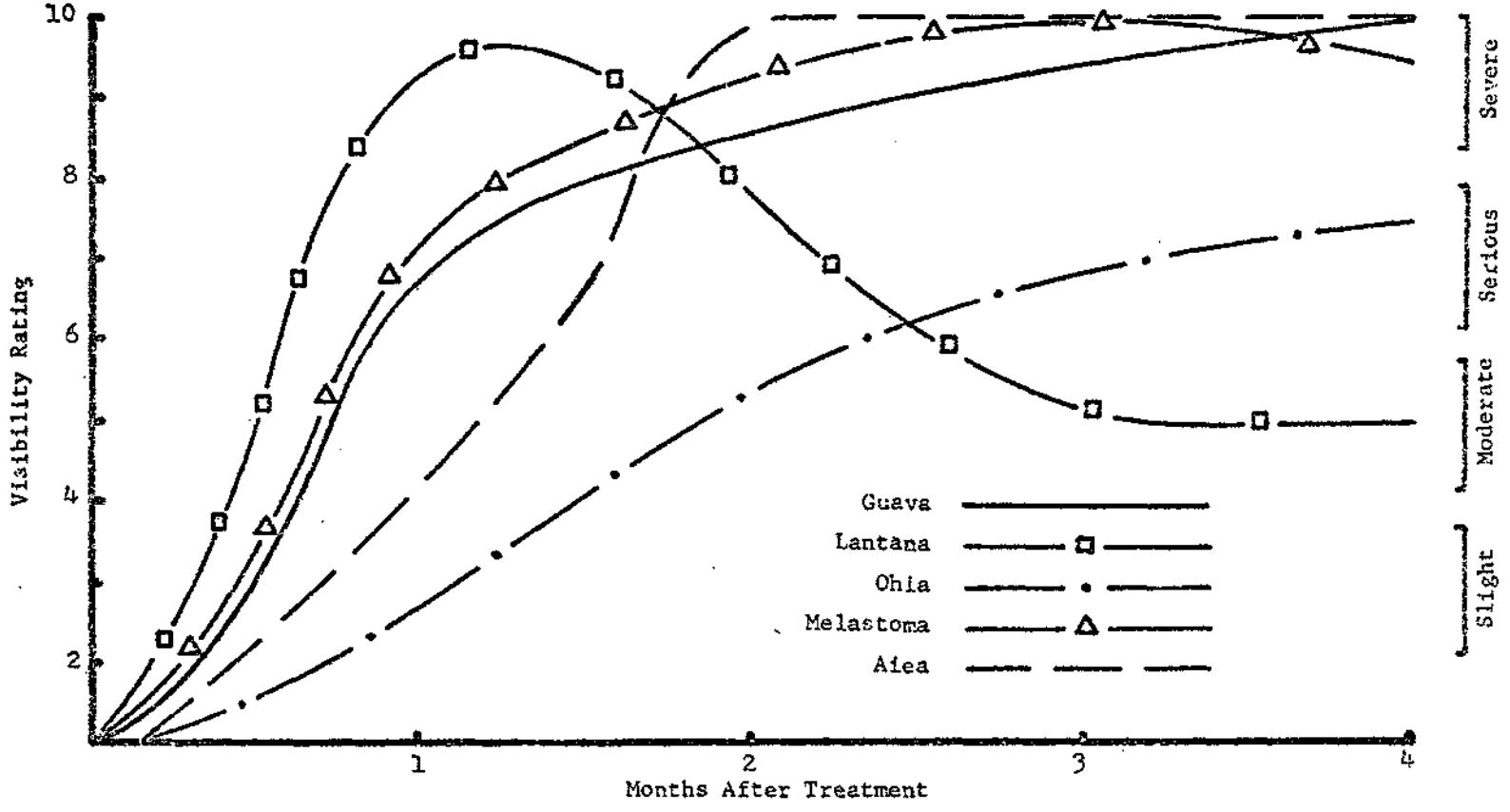

FIG. 8: EFFECT OF ORANGE AT 12 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

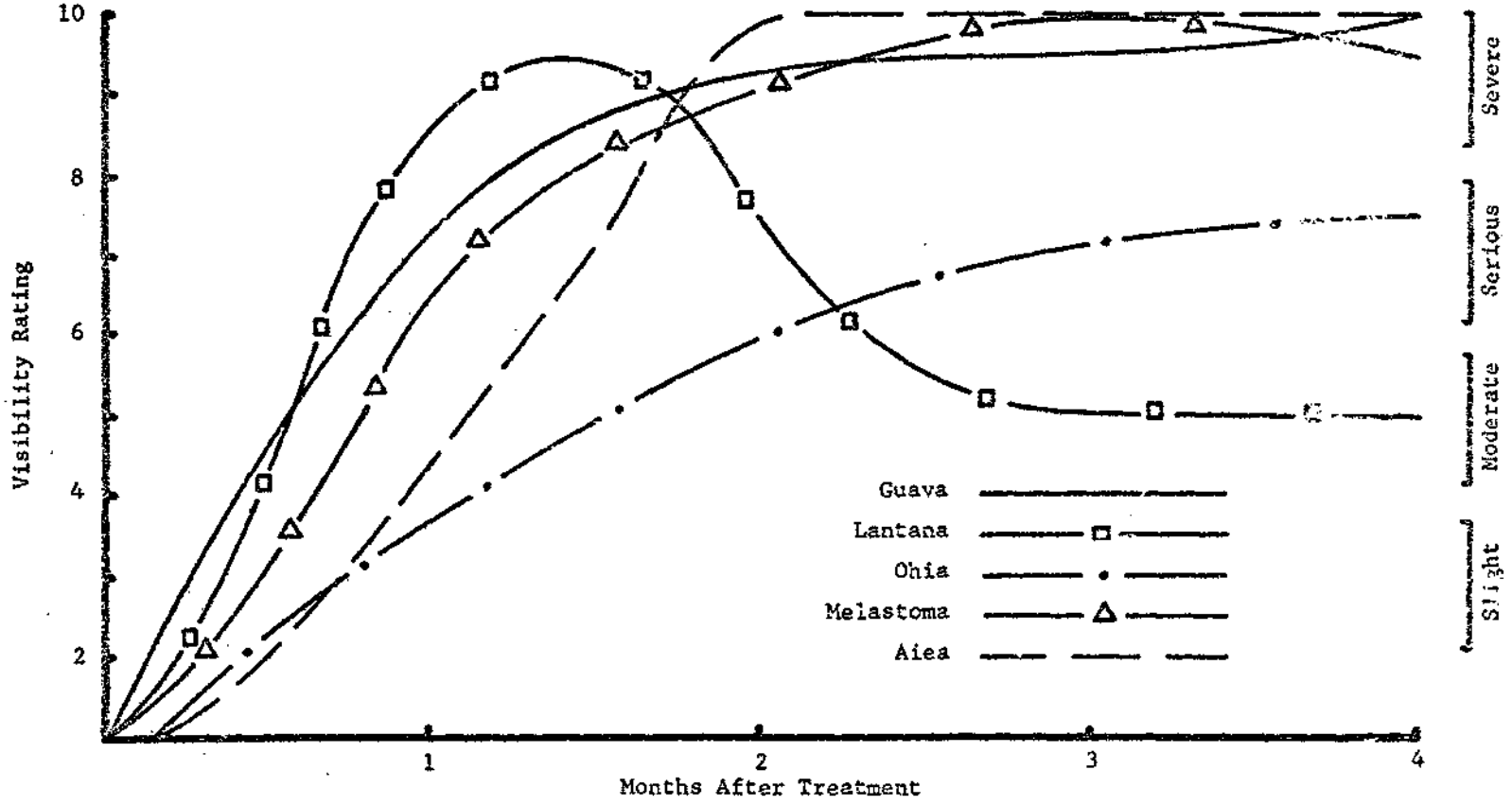

FIG. 9: EFFECT OF ORANGE + PCP AT 12 + 12 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

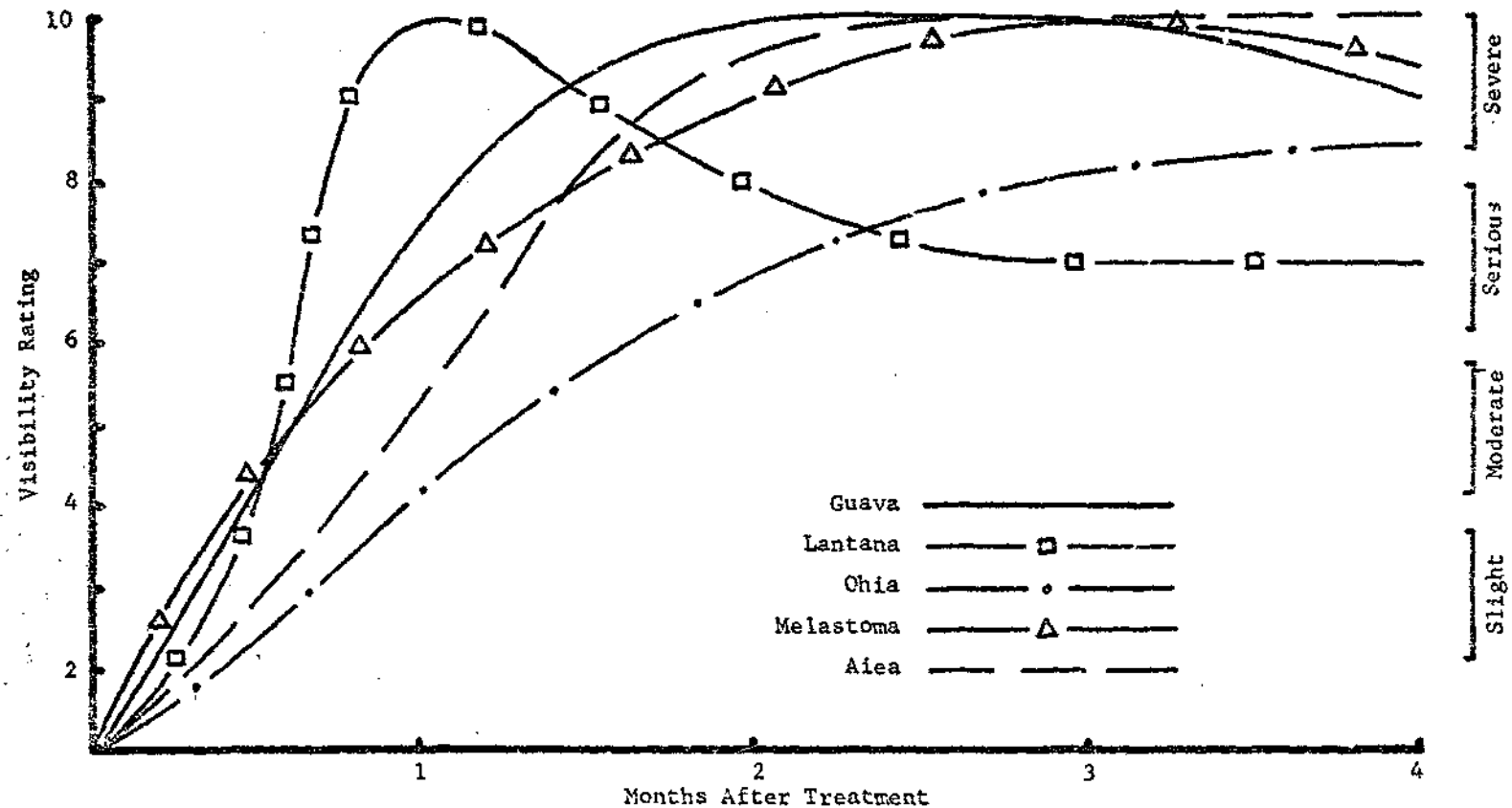

FIG. 10: EFFECT OF ORANGE + DNBP AT 8 + 12 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

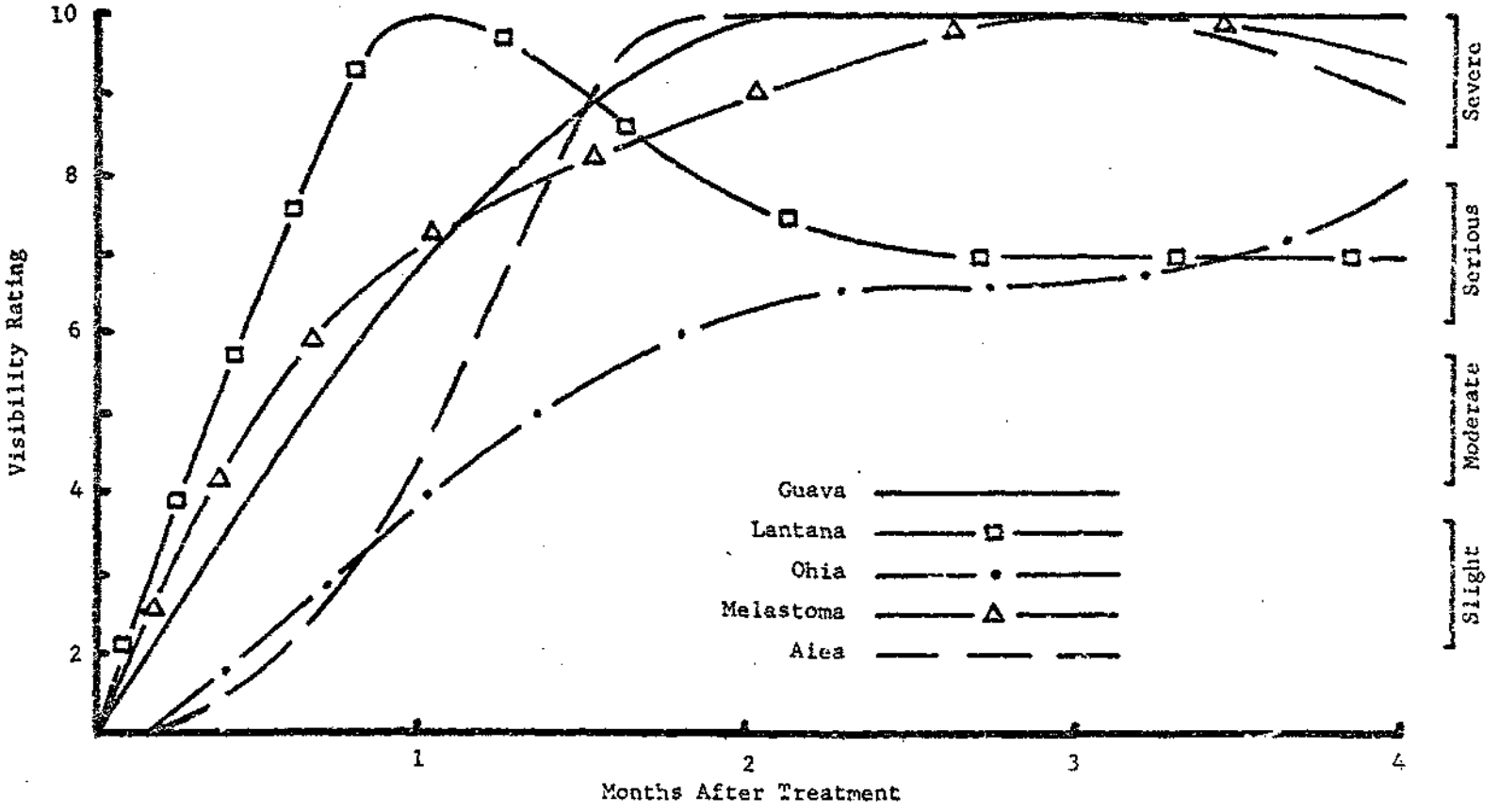

FIG. 11: EFFECT OF ORANGE + PHYTAR AT 12 + 6 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

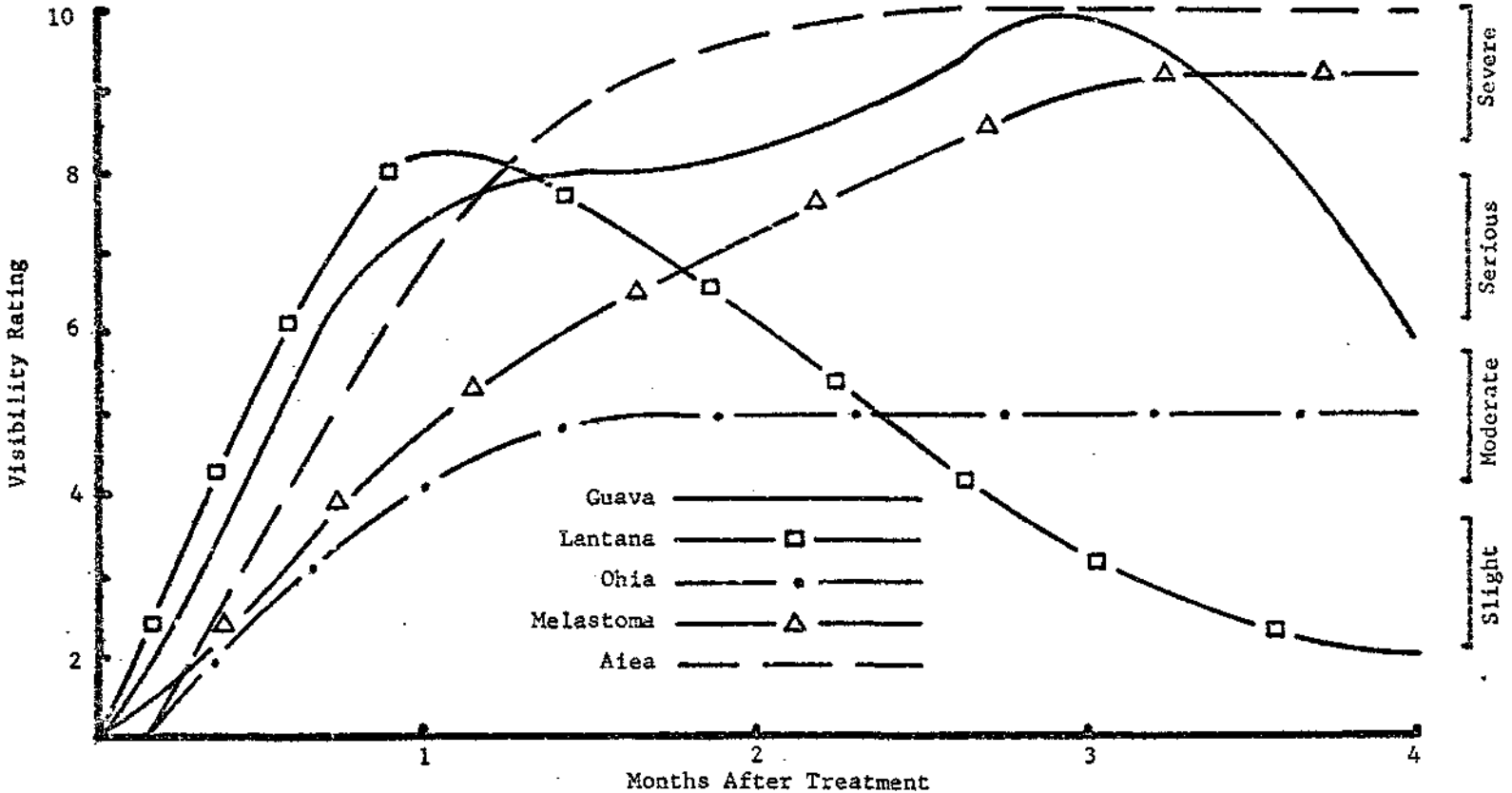

FIG. 12: EFFECT OF PCP + PROPANIL AT 6 + 6 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

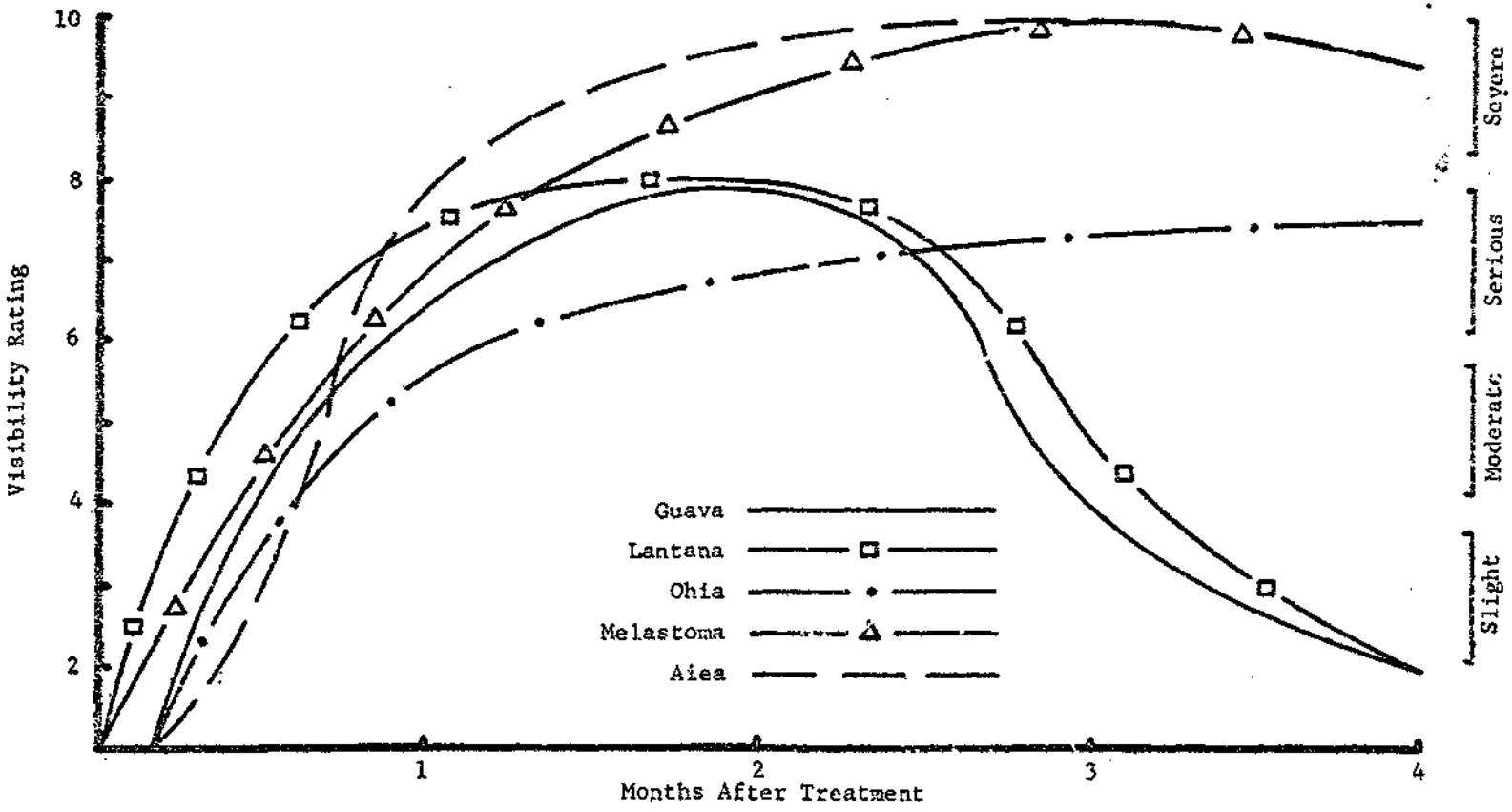

FIG. 13: EFFECT OF DES-I-CATE + PARAQUAT AT 1 + 3 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

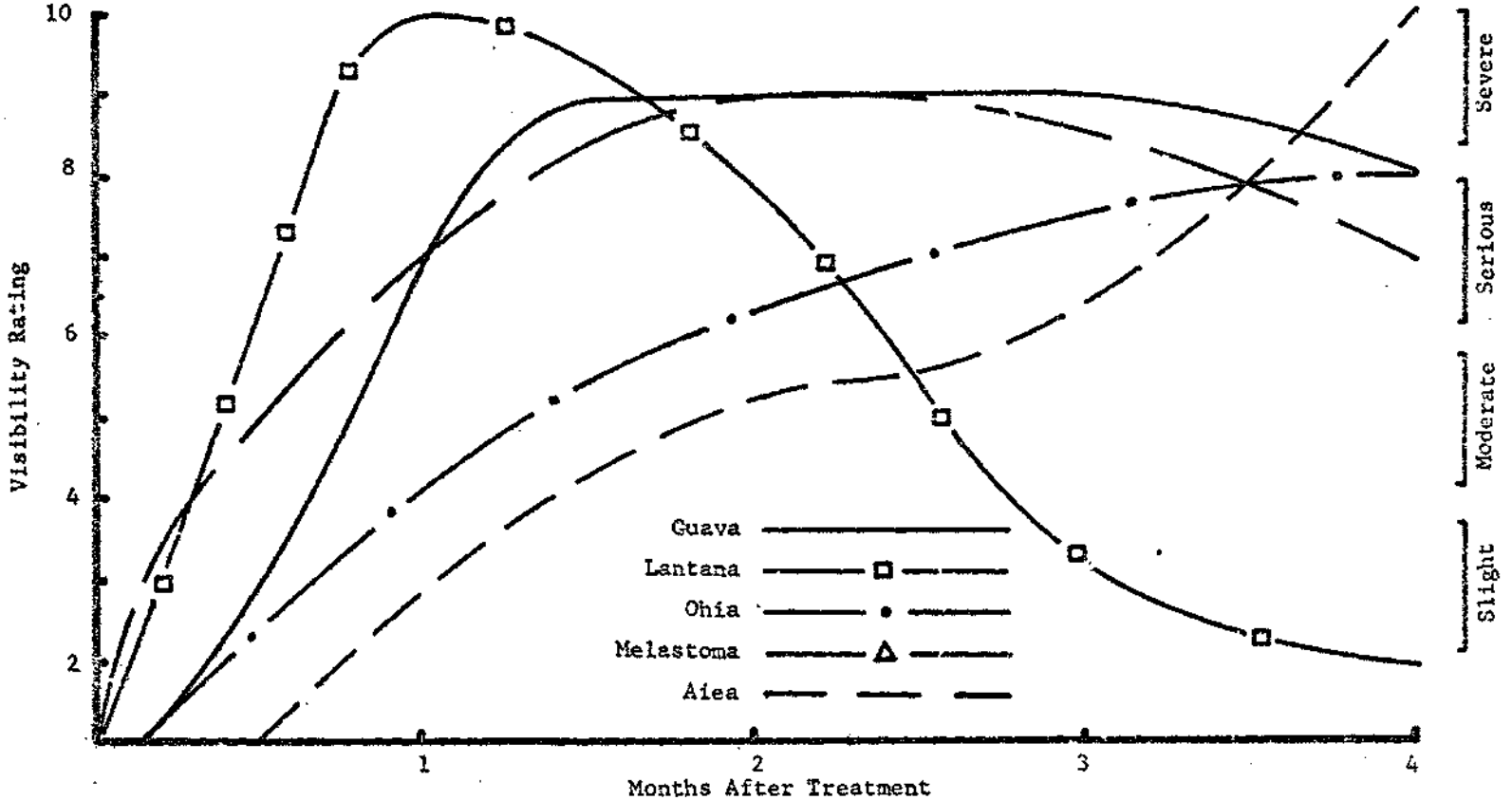

FIG. 14: EFFECT OF AP-20 + ORANGE AT 6 + 12 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

TABLE 10: SERIES III, RAPID DEFOLIANT-SYSTEMIC COMBINATIONS PERIOD WHEN SERIOUS DEFOLIATION OCCURS (VISIBILITY RATING > 6.5) ON SEVERAL WOODY SPECIES*

Chemical lb/acre	Ohia	Lantana	Guava	Kalia	Aiea	Ohia-ha	Staghorn Fern**
ORANGE (12)	n	1m	1m	1m	n	n	2w
ORANGE + PCP (12 + 12)	n	1m	1m	1m	n	n	2w
ORANGE + DNBP (12 + 7.5)	n	1m	1m	1m	1m	n	2w
ORANGE + DNBP (8 + 12)	n	1m	1m	1m	n	n	2w
ORANGE + PHYTAR (12 + 6)	n	2w	1m	n	n	n	2w
PCP-Propanil (QI-99)(6 + 6)	n	1m	1m	1m	1m	n	2w
PCP-Propanil (QI-99) (12 + 12)	n	1m	2w	1m	1m	n	2w
PCP + PHYTAR (6 + 6)	n	1m	1m	n	n	--	1m
DES-I-CATE (3)	n	1m	1m	--	n	n	2w
DES-I-CATE + Paraquat (3 + 1)	n	1m	1m	--	--	1m	2w
DES-I-CATE + Paraquat (1 + 3)	n	1m	1m	--	1m	n	2w
DES-I-CATE + ORANGE (2 + 8)	n	1m	1m	--	--	n	2w
AP-20 + ORANGE (6 + 12)	n	1m	1m	--	n	n	2w
AP-20 + PHYTAR (6 + 6)	n	1m	(?)1m	n	n	n	1m

* Results complete for 1 month only
n = none, w = weeks, m = months
**Injury 6.5

Photo 12a: Effect of ORANGE + DNBP 12 + 7.5 lb/acre on jungle species after 2 weeks.

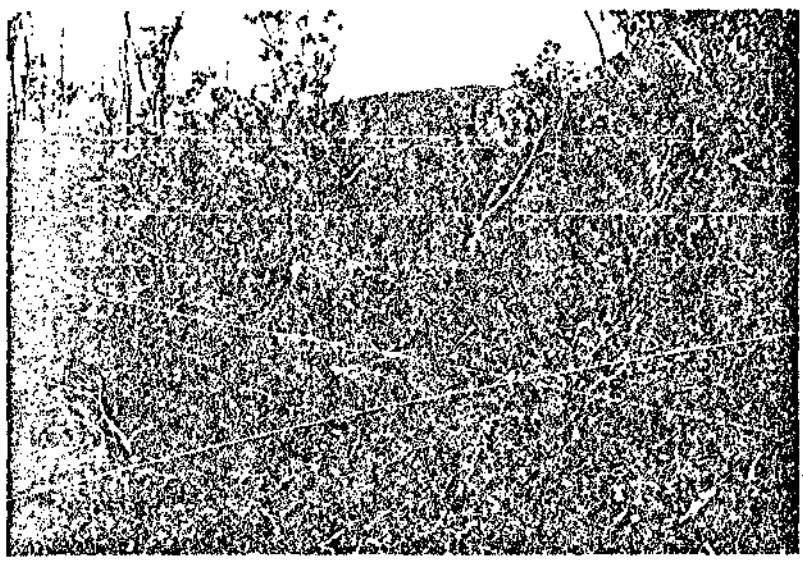

Photo 12b: Effect of ORANGE + AP-20 12 + 6 lb/acre on jungle species after 2 weeks.

effect of this chemical is presented in Photo 13b. Considerable vegetative injury within 2 weeks is evident following treatment with QI-99 at 12+ 12 lb/acre. At this period, guava was already seriously defoliated with no significant sign of regrowth at the 4-month period.

Other woody species like lantana, melastoma, kalia, and aiea were also seriously defoliated by the first month.

PCP in combination with ORANGE and with PHYTAR responded similarly to QI-99 throughout the test period.

DES-I-CATE Treatments

Of those woody species represented in DES-I-CATE plots, lantana and guava were seriously defoliated within the first month following treatment. Defoliation of ohia was almost serious at the 1-month stage with combinations of paraquat. It is anticipated that the endothal-paraquat combination will be one of the better treatments in this series.

Some of the common natives such as kalia and aiea were deficient throughout these plots and defoliative effects on these species are unknown.

AP-20 Treatments

The initial use of AP-20 in series II did not appear to be very effective as a rapid defoliant. In series III in combination with ORANGE and with PHYTAR, only lantana and guava produced serious defoliation effects at the 1-month period. However, every treatment incorporated in this series showed significant effects on both species within this period. Refoliation was nearly complete as the 4-month period.

Ohia, kalia, aiea, and ohia-ha remained only slightly affected within the initial month, and never attained serious levels of defoliation.

Resume'

All treatments produced serious defoliation of lantana and guava within the first month after treatment. Ohia and ohia-ha remained slight to moderately defoliated. These species showed serious defoliation by the second month through the 4th month.

From the start, ORANGE and its combinations produced dramatic changes on individual species as well as visibility of entire treated plots. The visibility increased slowly after the period of rapid desiccation, as a result of progressive leaf drop. The ORANGE treatments showed superior activity over other materials.

Series IV

Systemic herbicides were employed in this test to study their immediate and term defoliation effects on some Hawaiian jungle species. The residual effects or long-term kill of woody species are of special significance in many

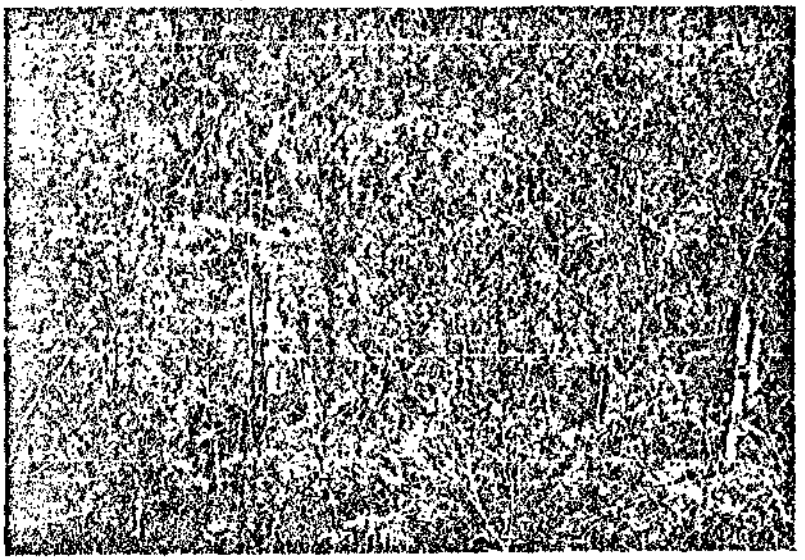

Photo 13a: Plot before treatment with PCP + Propanil (CI-99) 12 + 12 lb/acre.

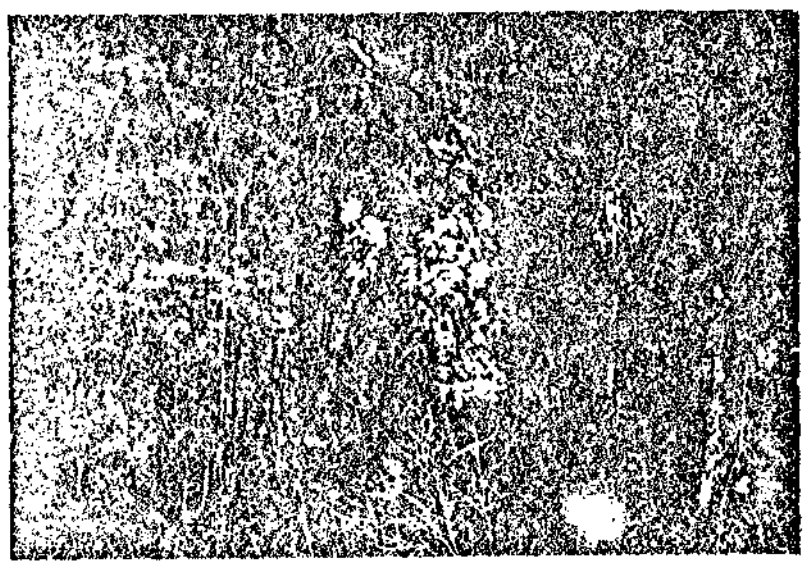

Photo 13b: Plot 2 weeks after treatment with PCP + Propanil (CI-99) 12 + 12 lb/acre.

situations. It is suggested that information gained from this investigation may aid in the development of an economically sound jungle clearance program throughout the tropics. Treatments were applied December 21, 1967.

To recapitulate, series IVH was located adjacent to series III at Hanahanapuni. The primary woody specie in this foothill area of Mt. Waialeale is ohia which occupies 30% of the total experimental area. Staghorn fern covers about 47% and melastoma, guava, and natives occupy the rest. Series IVM was located at Moalepe where a suitable tree-shrub-grass intermixed vegetation was available for the thorough study of M3189 and M3190 materials. Each treated plot was approximately 5 acres as compared to smaller 2-acre plots in series I, II, and III.

All except one of the chemicals employed were systemics. A single treatment of diquat in combination with the potassium salt of picloram was also applied. The systemic herbicides were picloram, 2, 4-D and 2, 4, 5-T applied individually or in various combinations. These were generally applied at 3 gallons per acre total delivery. Diesel oil was used as a diluent whenever required. Extreme care was utilized during spray application and in the disposal of excess chemicals and empty containers.

Visibility and injury data for a 6-month period were obtained. These are presented in Tables 16 and 17 in the Appendix. The effect of time on defoliation is shown in Figures 15 to 19.

TORDON 101 (Picloram-2, 4-D) Treatments

TORDON 101 consists of picloram ester and 2, 4-D (refer Table 2 for further description). It was applied at 1.5 + 6 and 3 + 12 lb/acre rates. The latter rate is comparable with other picloram treatments.

For the woody species only, ohia and lantana were represented in TORDON 101 plots. Both species were seriously defoliated 2 months after treatment (Table 11). No noticeable refoliation occurred in these species during the first month after treatment but developed later for lantana, and melastoma. Staghorn fern was seriously injured in 3 weeks, although the visibility rating at first remained unchanged. As a result of settling of the matted growth from the 6 to 8 foot level to about 4 feet, visibility increased to serious ratings after 3 months.

M3142 (Picloram) Treatments

Both rates of M3142 (3 and 6 lb/acre) applied singly, caused serious defoliation of ohia at 2 months. Serious ohia defoliation was also observed at the same period when M3142 was combined either with silvex or ORANGE. The before-and-after effect on ohia by M3142 + silvex (3 + 9 lb/acre) is shown in Photos 14a and 14b. Complete kill of this specie is expected. No regrowth was noted at the 6 month period.

The defoliation period of several woody species including ohia, guava, lantana, and alea after M3142 (6 lb/acre) treatment are shown in Figure 15. Response by guava is gradual and reaches a stage of serious defoliation 3 months

TABLE 11: SERIES IVH, SYSTEMICS
PERIOD WHEN SERIOUS DEFOLIATION OCCURS
(VISIBILITY RATING> 6.5) ON SEVERAL WOODY SPECIES*

Chemical lb/acre	Ohia	Lantana	Waiwi	Guava	Aiea	Ohia-Ha	Staghorn Fern**
TORDON 101 (1.5 + 6)	n	2m	--	--	n	--	3w
TORDON 101 (3 + 12)	2m	2m	--	--	--	--	3w
M3142 (3)	2m	3w	--	--	3m	--	3w
M3142 (6)	2n.	3w	1m	3m	2m.	--	1n.
M3142 + Silvex (3 + 9)	2m	3w	--	2m	2m	3m	3w
M3142 + ORANGE (3 + 18)	2m	3w	1m	2m	2m	3m	3w
M3140 (3 + 12)	2m	3w	3w	1m	2m	2m	3w
M3140 (4.5 + 18)	2m	(?)3w	3w	2m	3m	--	3w
M3140 + Dowco 224 (2 + 16)	n	3w	1m	2m	2m	3m	2m
ORANGE (16 a.e.)	2m	3w	--	3w	2m	--	3w
ORANGE (24 a.e.)	2m	(?)3w	3w	3w	2m	(?)3m	3w
TORDON 22k + ORANGE (4 + 8)	2m	3w	3w	2m	2m	2m	1m
TORDON 22k + Diquat (3 + 3)	1m	(?)3w	3w	1m	2m	1m	3w

* n = none, w = weeks, m = months
** Injury> 6.5

Photo 14a: Ohia before treatment with M3142 + Silvex 3 + 9 lb/acre.

Photo 14b: Ohia 3 months after treatment with M3142 + Silvex 3 + 9 lb/acre.

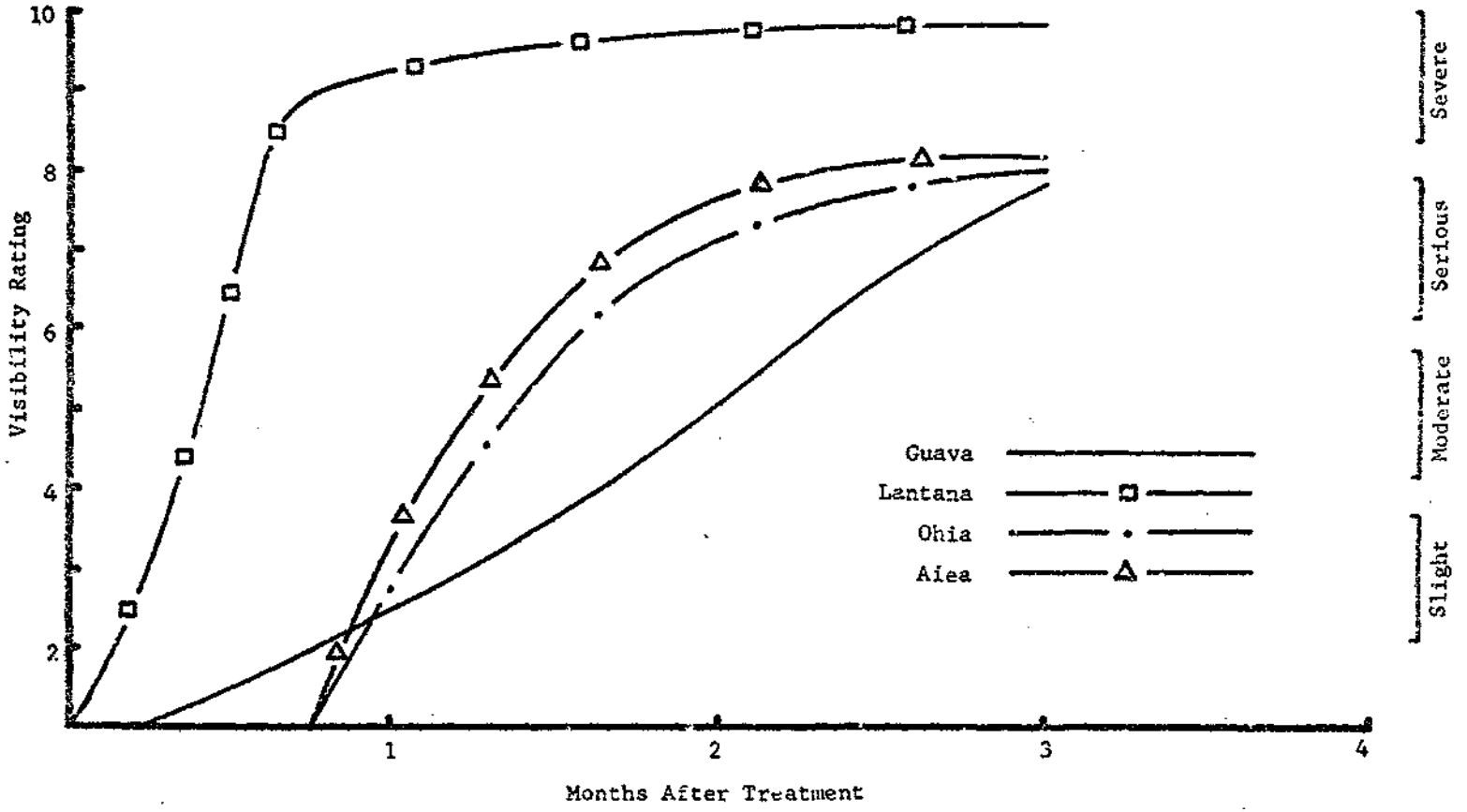

FIG. 15: EFFECT OF M3142 6 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

after treatment. Lantana, on the contrary, defoliates rapidly within 2 to 3 weeks and is almost completely killed at 6 weeks. Some regrowth on lantana was evident after 3 months. Defoliation response by aiea was similar to that of ohia.

The combination of M3142 + ORANGE (3 + 18 lb/acre a.e.) proved effective in seriously defoliating all the major woody species. The overall effect from this treatment at 3 weeks and 2 months are shown in Photos 15a and 15b, respectively. Visibility is dramatically increased by the 2 month period.

The periodic defoliation effect of individual woody species is depicted in Figure 16. The action on guava is more rapid and severe than from picloram alone. No terminal regrowth was observed on guava at the 3 month rating period. Lantana and ohia responded similarly to picloram, with or without ORANGE.

In comparing the M3142 + ORANGE combination with M3140 there is a similar periodic defoliation response by the woody species. The extent of guava defoliation between 1 week and 3 months is greater with M3140.

M3140 (Picloram-ORANGE) Treatments

The periodic defoliation effect of M3140 (3 + 12 lb/acre) on guava, ohia, waiwi, and aiea is shown in Figure 17. These species were severely defoliated at the end of 3 months.

The effect of M3140 at (3 + 12 lb/acre) on ohia 1 and 3 months after treatment is shown in Photos 16a and 16b, respectively. It is apparent that the greatest defoliation occurs between the first and third months following application.

The defoliation effect of the higher rate of M3140 (4.5 + 18 lb/acre) on most of the principal woody species were similar to that of the lower rate. No significant differences were observed between rates.

Ohia was moderately injured but only slightly defoliated even at 3 months after treatment with the M3140 + Dowco 224 combination at 2 + 16 lb/acre. Defoliative response by the other woody species was similar to that of other M3140 rates. Comparison of M3140 + Dowco 224 with TORDON 101 (3 + 12 lb/acre), and with M3142 + ORANGE suggests that serious ohia defoliation should have occurred 2 months after treatment. Since this result was not observed for the former treatment, there could be some question regarding the actual quantity of application. No deficiencies were observed however. It appears therefore that the Dowco combination is ineffective. Regrowth was general after the 2nd month.

ORANGE (2, 4-D-2, 4, 5-T) Treatments

Both rates of ORANGE were exceptionally effective in defoliating all the major woody species. By the 3 week rating period, melastoma, lantana, waiwi and guava were seriously defoliated. Ohia and aiea were seriously

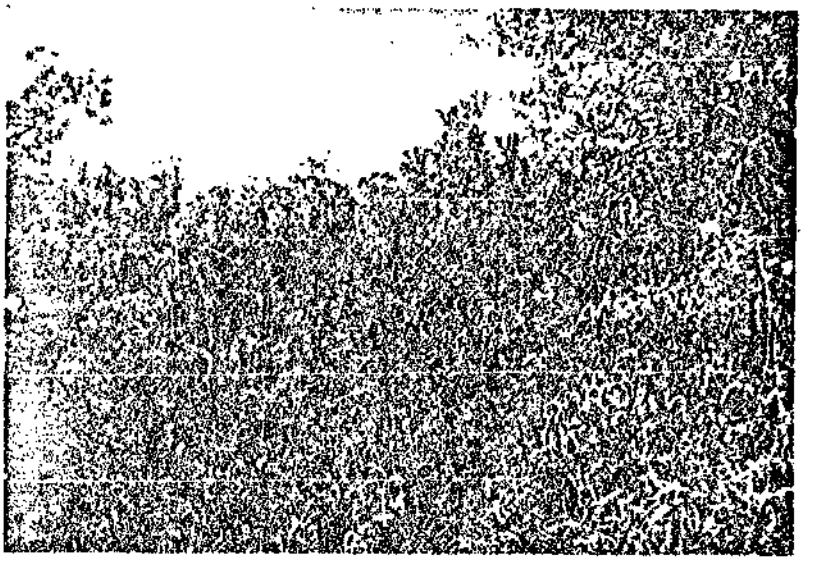

Photo 15a: Plot 3 weeks after treatment with M3142 + ORANGE 3 + 18 lb/acre.

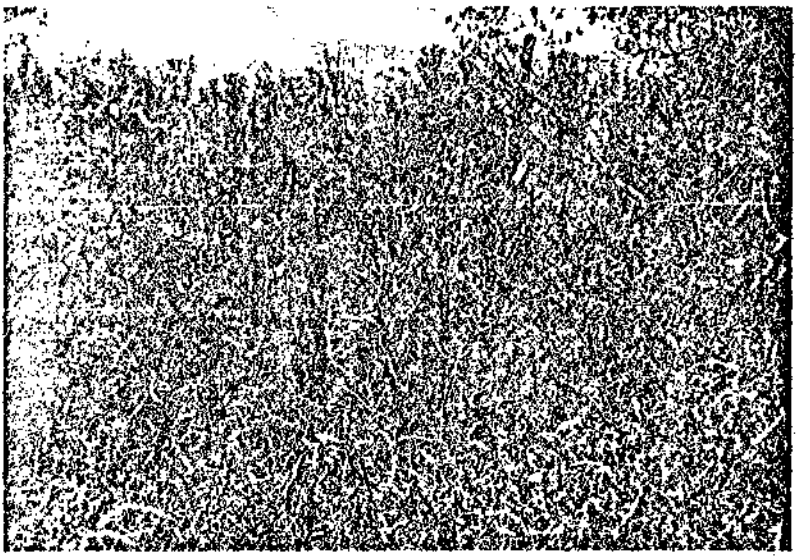

Photo 15b: Plot 2 months after treatment with M3142 + ORANGE 3 + 18 lb/acre.

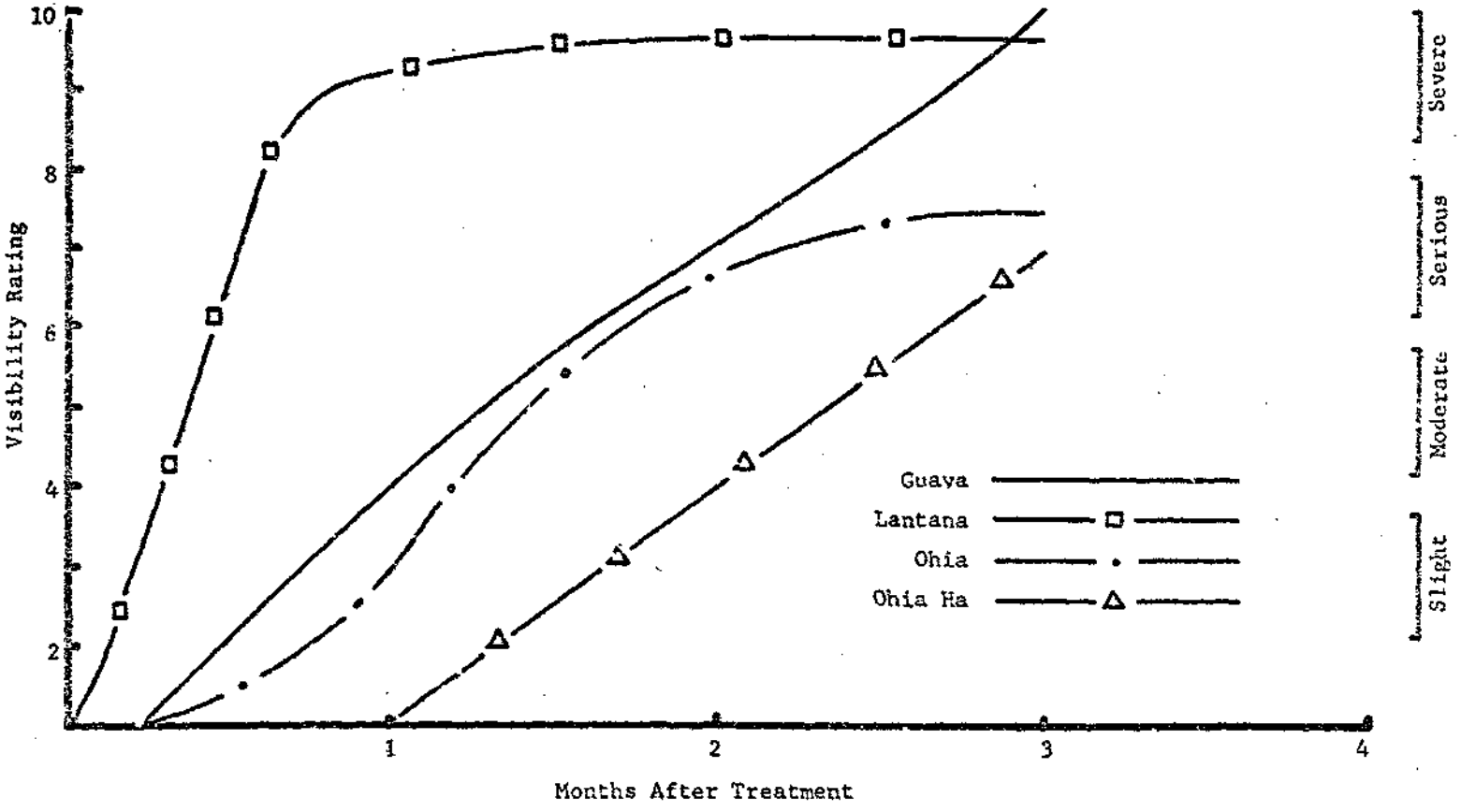

FIG. 16: EFFECT OF M3142 + ORANGE 3 + 18 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

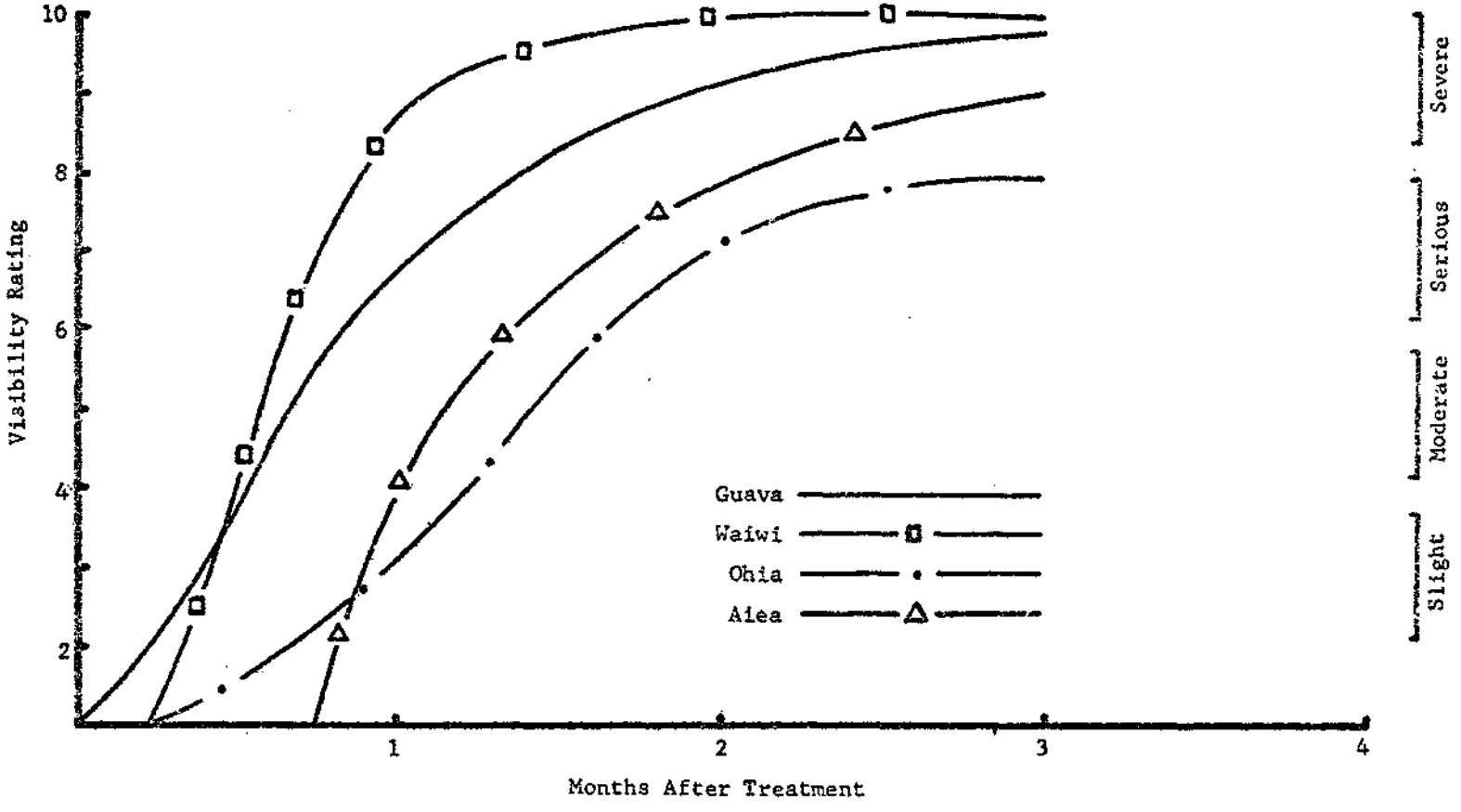

FIG. 17: EFFECT OF M3140 3 + 12 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

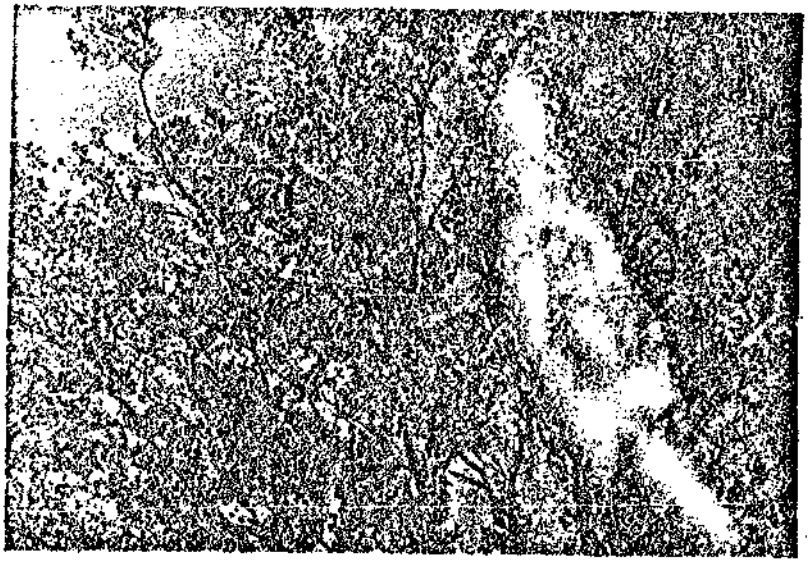

Photo 16a: Ohia 1 month after treatment with M3140 3 + 12 lb/acre.

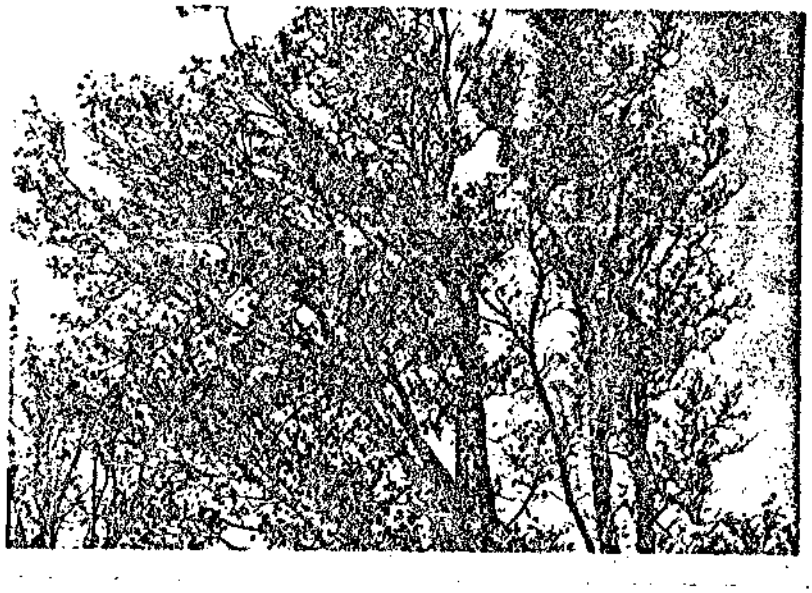

Photo 16b: Ohia 3 months after treatment with M3140 3 + 12 lb/acre.

defoliated after 2 months. The periodic defoliation effects on some of the species are shown in Figure 18. It is apparent that ORANGE 24 lb/acre a.e. (12 lb-2, 4-D and 12 lb-2, 4, 5-T) defoliates fairly rapidly and is effective for a long period.

The duration of effective defoliation from ORANGE treatment is shown in Photos 17a and 17b. Waiwi does not show any sign of regrowth after 6 months from ORANGE 24 lb/acre treatment, whereas considerable regrowth is evident following TORDON 22K + ORANGE (4 + 8 lb/acre) treatment. Waiwi was completely defoliated by the latter treatment after the first month but soon showed some recovery.

There were no differences in specie responses due to ORANGE rates, thus 16 lb/acre being just as effective in defoliating the major species as 24 lb/acre.

TORDON 22K Treatments

TORDON 22K is the potassium salt of picloram and differs from the ester formulation of picloram which is a component of M3142 and M3140.

The combination of TORDON 22K + ORANGE at 4 + 8 lb/acre and TORDON 22K + diquat at 3 + 3 lb/acre were very effective in defoliating all the principal woody species. The inclusion of diquat caused earlier defoliation of ohia which was severe within one month following treatment. TORDON in combination with ORANGE did not produce comparable defoliation until 2 months after treatment. The rapid effect of the diquat combination was also apparent with guava and ohia-ha after 1 month. These effects are shown in Figure 19. Waiwi regrowth was observed after 2 months regardless of whether TORDON 22K was combined with ORANGE or with diquat.

Response of woody species to TORDON 22K + ORANGE, and TORDON ester + ORANGE were similar. Most items were severely defoliated by the second month and effectively controlled through the 6th month. It is anticipated that many of these species will remain adequately controlled for over a year.

Photos 18a and 18b depict the results of TORDON + diquat in defoliating some woody species, mainly ohia, at the 1 week and 3 week periods, respectively. No significant regrowth on ohia was observed even after 6 months.

M3189 (Picloram-Dalapon) Treatments

Three rates of M3189 were incorporated in this test and all were effective in severely defoliating ohia, melastoma, lantana, guava, javaplum, and christmasberry. The period at which serious defoliation of these woody species occurred is presented in Table 12. Lantana and guava showed considerable regrowth by the third month.

The high rate of M3189 (4 + 26 lb/acre) was also effective on hau and the extent of defoliation at the 1 month period is shown in Photo 19a.

Injury response by grasses were variable. Although hilograss was not significantly injured by any of the M3189 treatments, yellow foxtail, molassesgrass, and ricegrass were seriously to severely injured at one period or

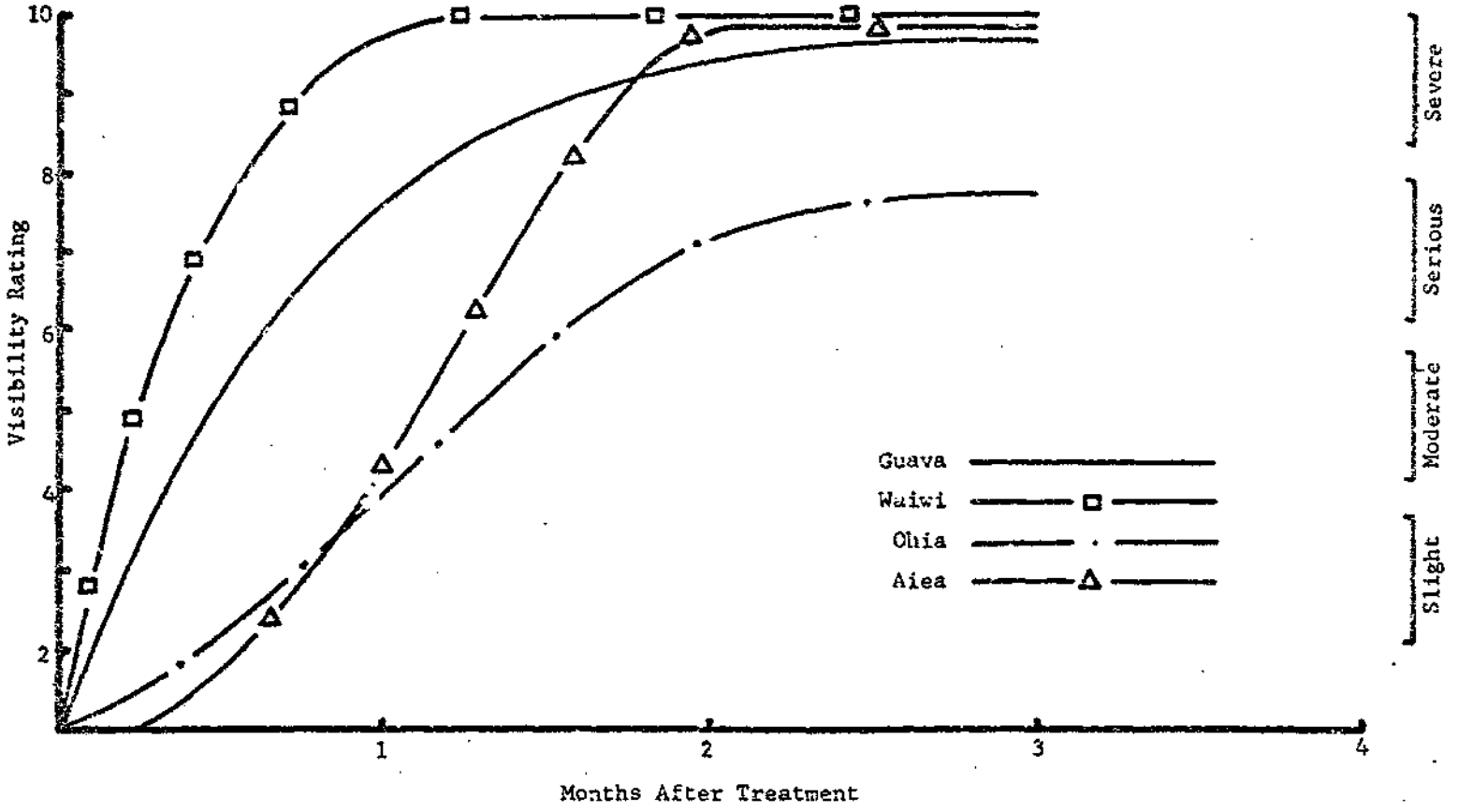

FIG. 18: EFFECT OF ORANGE (M3151) 24 LB/ACRE a.e. ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

Photo 17a: Waiwi 3 months after treatment with ORANGE 24 lb/acre a.e.

Photo 17b: Waiwi 3 months after treatment with TORDON 22K + ORANGE 4 + 8 lb/acre.

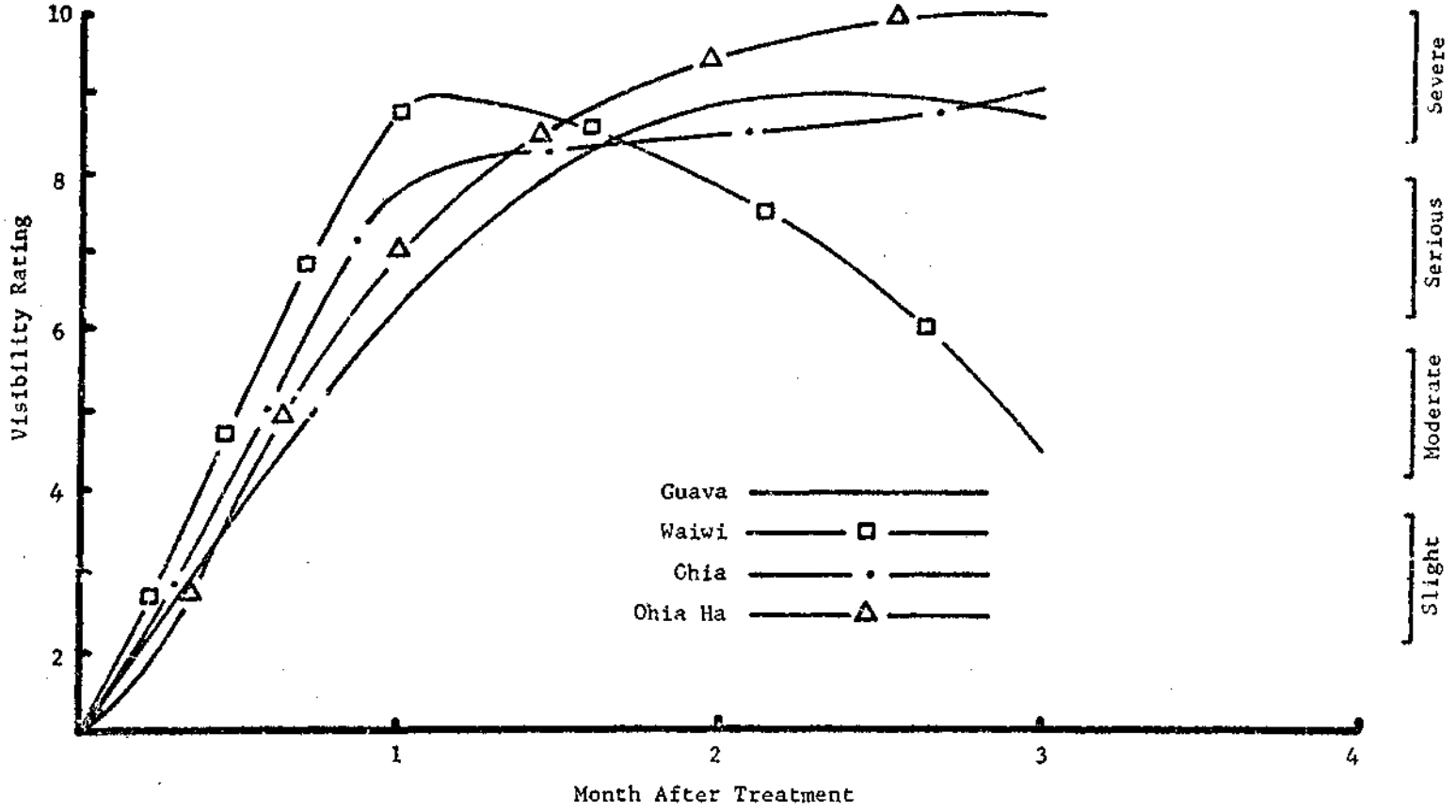

FIG. 19: EFFECT OF TORDON 22K + DIQUAT 3 + 3 LB/ACRE ON DEFOLIATION PERIOD OF SEVERAL WOODY SPECIES.

Photo 18a: Plot 1 week after treatment with TORDON 22K + Diquat 3 + 3 lb/acre.

Photo 18b: Plot 3 weeks after treatment with TORDON 22K + Diquat 3 + 3 lb/acre.

TABLE 12: SERIES IVM, SYSTEMICS
PERIOD WHEN SERIOUS DEFOLIATION OCCURS
(VISIBILITY RATING > 6.5) ON SEVERAL WOODY SPECIES*

Chemical m lb/acre	Ohia	Lantana	Guava	Java Plum	Hau	Christmas-berry	Hilograss**
M3189***							
2 + 13	1m	1m	1m	1m	--	(?)2m	n
3 + 19.5	2m	1m	1m	2m	n	3w	n
4 + 26	2m	3w	1m	2m	1m	3w	n
M3190***							
1.5 + 1.5 + 10.5	n	1m	n	n	n	1m	n
2 1/4 + 2 1/4 + 15 3/4	2m	1m	3w	3m	3m	(?)3w	n
3 + 3 + 21	3m	3w	1m	2m	2m	(?)3w	2m

* n = none, w = weeks, m = months
** Injury 6.5
*** See Table 2 for chemical composition

Photo 19a: Ilau 1 month after treatment with M3189 (4 + 26 lb/acre).

Photo 19b: Rhodomyrtus 2 months after treatment with M3190 (3 + 3 + 21 lb/acre).

another. Of these grasses, molassesgrass was the most sensitive to the dalapon component and was severely injured by the 3 week interval. No significant sign of regrowth was evident even after a 3 month period. Yellow foxtail and ricegrass were definitely injured at 2 months but had generally recovered by the third month. Swordfern in the open were killed at 4 months, with no recovery shown at 6 months. Protected swordfern showed little effect from treatment.

M3190 (Picloram-2, 4, 5-T-Dalapon) Treatments

The lowest rate of M3190 (1.5 + 1.5 + 10.5 lb/acre) are not effective in seriously defoliating ohia, guava, javaplum, and hau. It did, however, cause defoliation of the more sensitive woody species such as lantana and christmasberry. As the rates were increased twofold all the principal woody species were seriously or severely defoliated.

The defoliative effect on rhodomyrtus 2 months after treatment with M3190 (3 + 3 + 21 lb/acre) is shown in Photo 19b. This species is of particular interest as none of the rapid defoliants were effective agents. No regrowth was evident at 3 months, however, as the branches were alive it is expected to refoliate.

Hilograss was injured at 2 months only by the high rate of M3190, but had already slightly recovered by 3 months. Both lower rates of M3190 caused only slight injury to hilograss throughout the rating period. The injury response by yellow foxtail, molassesgrass, and ricegrass to M3190 were similar to that caused by M3189. Only molassesgrass and possibly yellow foxtail showed signs of being completely eradicated while ricegrass had almost completely recovered by the third month. The injury to grasses, mainly molassesgrass, at 2 weeks and 3 months after treatment with M3190 is shown in Photos 20a and 20b, respectively.

Resume'

Picloram alone or in combination with diquat; 2, 4-D; 2, 4, 5-T; or 2, 4, 5-TP effectively defoliated and injured all the major woody species. Ohia, aiea, and ohia-ha generally took about 2 months before producing signs of serious defoliation. The more sensitive woody species such as lantana, waiwi, and guava were seriously defoliated in less than 2 months. However, refoliation rapidly developed on these sensitive species, and together with regrowth of grasses, showed little effect from the treatments after 5 or 6 months.

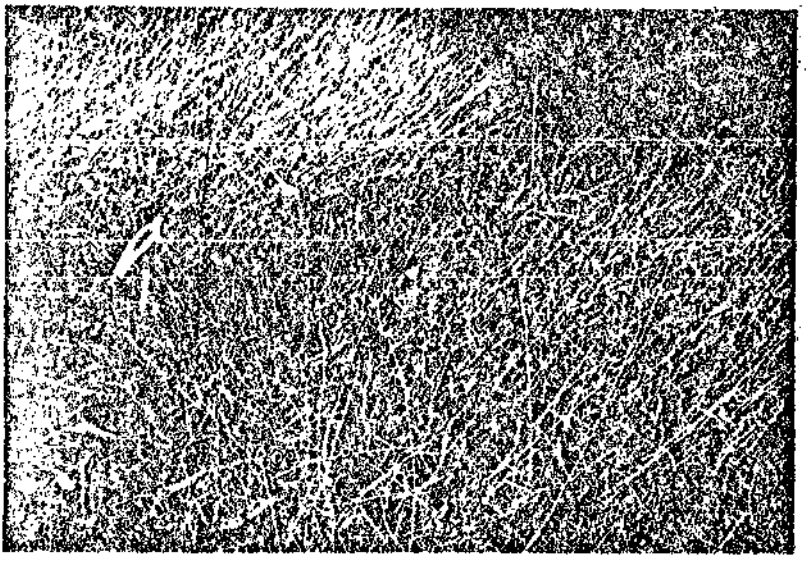

Photo 20a: Grasses 2 weeks after treatment with M3190 (2-1/4 + 2-1/4 + 15-3/4 lb/acre).

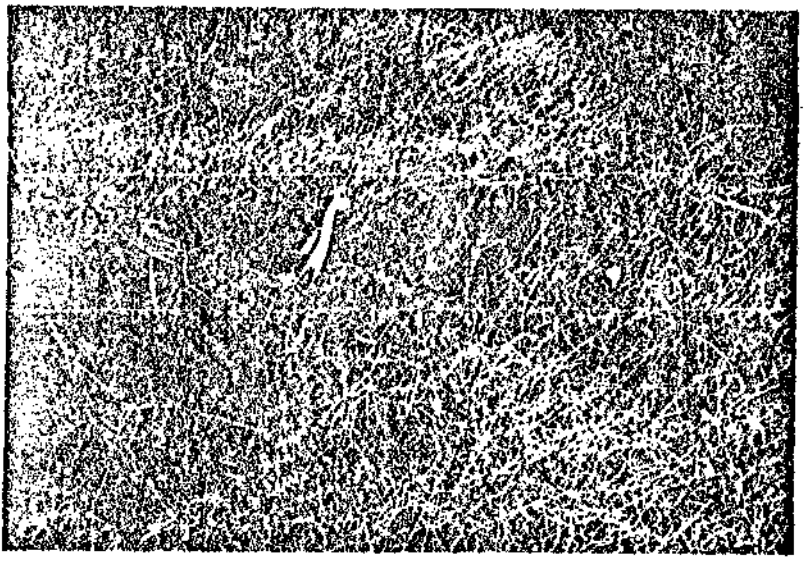

Photo 20b: Grasses 3 months after treatment with M3190 (2-1/4 + 2-1/4 + 15-3/4 lb/acre).

SUMMARY

Four series of field tests were installed near the Kauai Branch of the Hawaii Agricultural Experiment Station to investigate the potentials of rapid defoliants and systemic herbicides in the control of Hawaii jungle vegetation. One objective was the assessment of the degree and duration of defoliation of vegetation by various pesticides. Another objective was the evaluation of the residual materials in eradicating diverse jungle vegetation in land reclamation. The effect of rapid defoliants is likely to be transitory whereas the residual herbicides have the potential for the rapid and effective removal of dense jungle. The destruction of jungle vegetation is basic to the reclamation and economic development of vast areas of jungle throughout the tropics, and their transformation into productive croplands.

The test sites lie at an elevation of 500 to 1,000 feet elevation within a mean monthly temperature range of 52 to 70°F, in the severely leached, low fertility wetlands, and receive an annual rainfall of 90 to 200 inches.

Some fifty herbicide treatments were aerially applied by Murrayair, Ltd. from July 1967 to February 1968. The response of the vegetation to treatment were recorded as visibility (defoliation) and injury (damage) ratings, utilizing a 1 to 10 decimal system. Photographs of pre-tagged principal woody species were obtained during each rating period. Ratings were made 1, 4, 7, 14, 30 days following treatment and on a monthly basis thereafter.

Paraquat, diquat, PHYTAR 560G, and pentachlorophenol were effective as rapid defoliants on several major woody species. Paraquat and diquat seriously defoliated ohia and christmasberry within 2 months following application. Diquat was more effective on javaplum than paraquat. Defoliation of these woody species was still quite effective after 4 months.

PHYTAR 560G and pentachlorophenol effectively defoliated guava, lantana, and christmasberry. Woody specie response to varying rates and volumes of these chemicals did not differ to any great extent. With PCP however, there was a tendency for more major species to be seriously defoliated as rates increased.

AP-20 was not effective as a single rapid defoliant nor in combination with ORANGE or PHYTAR.

Diquat + PHYTAR at 6 + 6 lb/acre was superior to other combinations of rapid defoliants on the basis of overall vegetative defoliation effect. The susceptible woody species were ohia, guava, javaplum, christmasberry, and lantana. All these species, except ohia, had refoliated considerably by the end of 4 months. The rapid refoliation is probably associated with the immediate defoliative effect of the diquat + PHYTAR combination soon after application, which leaves little time for full absorption of the toxic material.

The overall effectiveness of other rapid defoliant combinations such as PCP + PHYTAR 6 + 6 lb/acre were slower to develop, but may be equally as effective over an extended period of time.

Systemic-rapid defoliant combinations of ORANGE + DNBP, propanil + PCP (QI-99), and DES-I-CATE + paraquat caused a fairly rapid and pronounced defoliation and injury effect on the overall vegetation. Lantana, guava, kalia, and aiea were included as seriously defoliated 1 month after these combinations were applied.

The most effective systemic-rapid defoliant combination treatment was TORDON 22K + diquat at 3 + 3 lb/acre. Within a month following application, ohia, ohia-ha, guava, lantana, and waiwi were seriously defoliated. The immediate overall defoliative effect was quite dramatic. Of the principal woody species evaluated, only waiwi had refoliated considerably at the end of 3 months. It is anticipated that in many of these species refoliation will be adequately delayed for over a year.

Picloram esters alone or in combination with 2, 4-D, 2, 4, 5-T, or 2, 4, 5-TP effectively defoliated and injured all the principal woody species. Serious defoliation generally occurred within 2 months. ORANGE, a combination of 2, 4-D and 2, 4, 5-T, was very effective as a defoliant, whether applied alone or in combination with other systemics and obviously, may also be lethal. Among the grasses, only molassesgrass was seriously injured over a 3 month period following treatment with picloram-dalapon combinations. Although most treatments were exceptional in overall short-term defoliation, further observation showed that at the end of 6 months all grasses had fully recovered.

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APPENDIX

TABLE 13: SERIES I, RAPID DEFOLIANTS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical, lb/acre	Period after Treat.	Guava		Lantana		Ohia		Java-plum		Melastoma		Hala		Christmas-berry		Waiwi		Silver Oak	
			V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I
1	Paraquat 4.7	1 da.	1.0	1.0	1.9	4.1	1.0	1.0	1.0	1.2	1.4	3.7	1.0	1.0	1.0	1.5	1.0	1.0	1.0	1.0
		4 da.	1.0	1.5	3.0	4.7	1.7	2.2	1.2	2.5	3.2	6.5	1.0	1.5	5.5	6.5	1.0	2.0	1.0	1.5
		1 wk.	1.2	2.7	5.5	7.7	3.2	3.7	1.7	4.0	4.5	8.0	1.0	2.0	--	--	1.0	1.5	5.0	5.5
		2 wk.	2.7	3.5	4.5	6.7	3.2	5.2	3.7	5.2	5.2	9.0	1.2	2.0	--	--	1.3	2.0	8.0	7.5
		1 mo.	2.5	4.0	4.2	4.5	4.2	4.2	5.2	4.5	6.7	9.5	1.0	1.7	--	--	1.0	1.2	6.5	5.5
		2 mo.	2.5	2.7	1.0	1.5	10.0	9.0	3.2	3.7	9.5	8.2	1.0	1.5	--	--	1.0	1.0	4.0	4.0
		3 mo.	2.3	2.7	1.3	2.0	6.7	7.0	3.7	7.0	7.5	8.5	1.0	1.7	3.5	4.0	1.5	1.5	2.0	3.0
		4 mo.	1.5	1.5	1.5	2.5	5.5	5.7	2.7	5.2	8.3	9.2	1.5	2.2	6.0	5.0	1.5	1.5	3.0	2.5
		5 mo.	5.0	5.0	3.0	3.0	5.0	5.0	4.0	6.3	8.3	8.3	1.3	3.0	5.0	5.0	1.5	1.5	2.5	3.0
		6 mo.	2.0	2.5	2.0	2.2	3.5	4.0	4.0	5.0	7.7	7.7	1.5	2.0	2.0	2.0	1.0	1.0	2.5	2.5
2	Paraquat 9.4	1 da.	1.0	1.4	2.6	6.0	1.0	1.2	1.0	2.2	1.9	6.6	1.0	1.2	1.0	1.7	1.0	1.0	--	--
		4 da.	1.0	2.2	4.0	7.7	2.0	4.2	1.3	2.7	3.7	8.2	1.0	2.0	1.7	5.0	1.0	1.2	--	--
		1 wk.	1.7	3.5	5.7	8.0	3.7	5.0	3.0	5.0	3.7	8.7	1.0	3.0	5.0	8.0	1.0	1.7	--	--
		2 wk.	2.5	3.7	6.0	7.0	4.2	5.0	4.5	5.2	5.0	9.0	1.7	3.2	6.5	9.2	1.5	2.5	--	--
		1 mo.	3.7	5.2	3.2	3.0	5.0	5.5	6.3	6.0	6.2	9.5	1.2	3.0	8.5	9.5	1.0	1.7	--	--
		2 mo.	2.2	3.2	1.2	1.2	7.0	7.0	3.0	3.5	9.7	9.0	1.0	1.5	6.7	5.7	1.0	1.0	--	--
		3 mo.	2.2	3.0	1.2	2.2	5.5	6.5	4.2	7.5	7.3	8.3	1.2	3.0	5.0	5.3	1.7	2.0	--	--
		4 mo.	1.5	1.5	1.7	2.5	7.0	8.0	2.0	5.2	9.0	9.2	1.2	2.0	5.2	5.0	1.6	1.6	--	--
		5 mo.	4.9	4.9	2.9	2.9	7.5	7.5	3.3	6.3	8.8	8.8	1.3	2.5	6.3	6.3	2.3	2.3	--	--
		6 mo.	2.0	2.2	1.7	2.2	5.7	6.2	2.7	4.5	7.0	7.0	1.2	1.7	5.2	5.2	1.5	1.7	--	--
3	Diquat 6	1 da.	1.0	1.1	1.7	4.0	1.0	1.3	1.0	2.2	2.1	5.9	1.0	1.0	1.0	1.3	1.0	1.0	1.0	1.0
		4 da.	1.0	2.7	3.0	5.3	2.5	4.0	3.0	5.0	4.2	8.5	1.0	1.5	1.0	5.0	--	--	1.5	2.5
		1 wk.	3.2	4.5	6.7	8.0	2.7	4.2	7.0	8.5	5.0	9.2	1.0	2.5	4.0	8.0	--	--	3.0	5.0
		2 wk.	3.5	5.0	6.2	7.2	4.5	6.5	7.0	8.5	4.7	9.0	1.5	3.2	5.7	9.7	--	--	4.0	7.0
		1 mo.	3.2	5.0	3.0	3.0	5.3	6.3	7.5	8.0	8.0	9.7	1.2	2.5	8.0	10.0	1.5	2.0	2.3	5.0
		2 mo.	2.0	1.7	1.5	1.5	6.0	5.7	2.7	3.7	8.5	7.0	1.2	1.5	8.0	5.7	1.0	1.0	1.0	1.0
		3 mo.	1.7	2.5	1.2	1.7	5.7	7.2	3.7	6.0	7.0	8.0	1.5	3.2	5.3	6.0	1.7	1.7	2.0	3.0
		4 mo.	1.2	1.2	1.5	1.5	6.0	6.3	2.0	4.0	8.5	9.0	1.0	1.7	4.3	3.7	1.0	1.0	4.0	3.0
		5 mo.	4.5	4.5	2.8	2.8	5.7	5.7	2.7	4.3	8.3	8.3	1.3	1.5	5.0	5.0	2.3	2.3	3.5	3.5
		6 mo.	2.5	2.7	1.7	2.0	6.0	6.2	1.5	2.5	7.2	7.2	1.2	1.7	4.0	4.5	1.5	1.7	1.0	1.5

TABLE 13 (Cont.): SERIES I, RAPID DEFOLIANTS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical lb/acre	Period after Treat.	Guava		Lantana		Ohia		Java-plum		Melastoma		Hala		Christmas-berry		Waiwi		Silver Oak	
			V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I
4	Diquat 12	1 da.	1.0	1.5	1.9	5.4	1.0	1.6	1.0	2.1	2.1	7.6	1.0	1.0	1.0	3.2	1.0	1.5	1.0	1.0
		4 da.	1.0	4.0	4.0	7.0	2.0	3.0	2.0	4.3	3.5	9.5	1.0	2.2	5.0	7.5	1.5	3.0	--	--
		1 wk.	3.7	6.0	6.0	8.5	--	--	5.3	7.3	5.0	9.2	1.0	3.0	5.0	8.5	1.3	2.0	--	--
		2 wk.	3.5	5.0	5.2	6.7	4.3	7.0	6.7	8.0	5.7	9.2	1.8	3.2	6.0	9.0	2.0	3.5	--	--
		1 mo.	6.5	5.7	2.5	3.2	4.0	5.0	8.0	8.7	7.0	9.3	1.3	2.5	--	--	--	--	--	--
		2 mo.	1.7	1.7	1.2	1.7	8.0	6.7	3.0	4.0	9.0	8.0	1.2	2.5	8.0	5.3	1.7	1.7	--	--
		3 mo.	2.2	3.2	1.2	1.7	7.0	7.7	2.7	5.0	7.7	9.0	1.7	3.7	6.0	6.0	1.5	2.5	2.0	2.0
		4 mo.	1.0	1.0	1.5	1.5	5.7	6.7	1.9	3.0	9.0	9.2	1.0	1.7	5.0	4.0	1.3	1.3	2.0	2.0
		5 mo.	4.0	4.0	2.8	2.8	3.8	4.3	2.5	3.8	8.3	8.2	1.8	3.0	3.3	3.3	1.7	1.7	3.0	3.0
		6 mo.	2.2	2.2	2.0	2.2	3.7	4.2	2.7	4.2	8.5	8.5	1.2	1.7	3.2	3.5	1.0	1.0	1.0	2.0
5	PCP 12	1 da.	1.0	2.1	2.0	5.1	1.0	1.4	1.0	2.2	1.2	6.1	1.0	1.4	1.0	2.0	1.0	1.6	1.0	2.0
		4 da.	1.7	4.5	3.2	4.7	2.2	3.2	--	--	4.7	8.7	1.0	1.7	---	--	--	--	--	--
		1 wk.	3.2	5.0	4.7	6.0	4.0	5.3	3.0	5.0	4.3	9.3	1.2	2.7	--	--	1.5	2.5	1.5	3.0
		2 wk.	5.7	6.5	4.0	5.7	3.7	6.0	4.0	6.3	6.0	9.0	1.7	3.2	8.0	9.7	5.0	3.5	2.5	4.0
		1 mo.	5.5	6.0	1.0	1.5	4.2	5.2	5.5	7.2	5.7	7.0	1.5	3.5	--	--	--	--	2.5	3.0
		2 mo.	1.5	1.5	1.0	1.0	4.7	4.7	1.0	1.0	8.0	8.2	2.7	3.7	--	--	1.5	1.5	--	--
		3 mo.	2.0	2.7	1.5	2.0	4.7	6.0	1.3	3.3	6.3	7.7	1.7	5.0	4.3	4.3	1.5	1.5	1.5	2.5
		4 mo.	1.2	1.2	1.5	1.5	3.5	4.0	1.0	1.0	9.0	9.2	2.2	3.2	2.0	2.0	2.0	2.0	2.0	1.5
		5 mo.	3.8	3.8	3.0	3.0	3.7	3.7	1.5	2.0	8.0	8.0	1.8	2.5	3.0	3.0	1.7	1.7	4.0	4.0
		6 mo.	3.0	3.2	1.7	1.7	3.0	3.2	1.0	1.0	5.7	5.7	1.2	1.5	3.0	3.3	1.5	2.0	2.0	2.0
6	PCP 24	1 da.	1.0	3.0	1.8	4.6	1.0	1.7	1.0	3.0	1.3	4.8	1.0	1.7	1.0	3.7	--	--	1.0	2.0
		4 da.	1.7	5.0	2.0	3.0	2.5	4.0	2.0	3.5	4.0	7.0	1.2	2.2	--	--	1.0	1.0	--	--
		1 wk.	4.0	6.0	4.0	5.7	4.0	5.5	3.0	5.0	4.0	8.7	1.2	2.7	8.5	9.0	--	--	--	--
		2 wk.	3.0	5.0	5.0	7.0	4.7	6.7	2.5	6.0	5.7	9.0	1.7	4.0	--	--	2.5	4.0	--	--
		1 mo.	5.0	5.7	1.2	1.5	4.0	5.7	--	--	5.2	7.0	1.5	3.5	--	--	--	--	--	--
		2 mo.	1.0	1.0	1.0	1.2	3.7	4.7	1.0	1.0	4.7	6.2	2.0	3.0	4.0	3.0	1.3	1.3	--	--
		3 mo.	1.7	2.0	1.5	2.0	3.2	4.2	1.7	3.3	6.7	7.7	1.5	3.5	2.3	3.0	1.0	2.0	--	--
		4 mo.	1.2	1.2	1.5	2.2	4.5	4.7	1.0	1.0	5.5	6.0	1.5	2.5	3.0	3.0	2.0	2.0	--	--
		5 mo.	3.5	3.5	3.3	3.3	3.0	3.0	1.7	3.0	6.0	6.0	1.3	2.3	4.0	4.0	2.5	2.5	--	--
		6 mo.	2.0	2.2	1.5	1.5	2.7	3.3	1.0	1.0	4.0	4.2	1.2	1.2	1.5	1.5	3.0	4.0	--	--

TABLE 13 (Cont.): SERIES I, RAPID DEFOLIANTS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical lb/acre	Period after Treat.	Guava		Lantana		Ohia		Java-plum		Melastoma		Hala		Christmas-berry		Waiwi		Silver Oak	
			V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I
7	PCP 40	1 da.	1.4	4.1	1.8	5.4	--	--	2.0	3.0	1.5	4.0	1.0	2.0	1.1	6.0	1.0	2.5	--	--
		4 da.	1.0	4.0	2.7	4.2	2.5	4.0	1.0	2.5	3.7	6.7	1.0	2.2	2.0	6.2	--	--	--	--
		1 wk.	4.0	6.0	5.0	6.2	4.0	5.5	3.0	5.0	5.3	8.3	1.7	3.5	6.5	9.0	--	--	--	--
		2 wk.	3.2	4.7	5.0	5.5	4.3	5.7	--	-	5.3	8.3	2.5	3.5	7.0	9.5	--	--	--	--
		1 mo.	4.5	5.0	2.0	1.7	4.0	5.3	5.5	7.5	4.7	6.2	2.0	4.7	--	--	--	--	--	--
		2 mo.	1.7	2.2	1.2	1.2	3.0	3.2	1.0	1.0	5.7	6.5	2.0	2.5	3.0	3.0	2.0	1.0	--	--
		3 mo.	2.0	2.5	1.5	2.2	3.5	4.2	1.5	3.5	4.0	5.2	1.7	3.7	6.0	6.0	--	--	--	--
		4 mo.	1.2	1.2	1.7	2.7	4.7	4.7	1.0	1.0	3.2	3.5	3.0	4.2	3.0	3.0	--	--	3.0	3.0
		5 mo.	5.0	5.0	2.8	2.8	3.0	3.0	2.0	3.5	6.0	6.0	2.5	3.0	5.5	5.5	3.0	3.0	4.0	4.0
		6 mo.	2.7	3.0	1.0	1.0	2.7	3.0	1.0	2.0	4.3	4.7	1.2	1.5	2.0	2.0	--	--	--	--
8	PHYTAR 6	1 da.	1.2	4.1	2.4	5.6	1.0	1.2	--	--	1.5	4.2	1.0	1.3	1.0	2.0	1.0	2.7	--	--
		4 da.	1.7	4.3	--	--	2.0	4.0	--	--	2.0	7.5	1.0	1.7	--	--	--	--	--	--
		1 wk.	4.7	6.5	6.3	8.3	2.7	3.3	--	--	5.0	7.7	1.0	2.7	--	--	--	--	--	--
		2 wk.	5.0	6.2	8.3	8.3	3.7	6.0	3.0	4.5	6.0	8.2	1.3	3.0	--	--	--	--	--	--
		1 mo.	3.7	4.7	2.2	2.7	4.0	5.2	5.0	7.5	5.0	6.5	1.5	3.2	--	--	--	--	--	--
		2 mo.	1.5	2.0	1.0	1.0	2.3	3.7	1.0	1.0	4.2	4.7	1.0	2.0	3.0	3.0	3.0	3.0	--	--
		3 mo.	2.0	2.5	1.5	2.2	3.0	4.5	1.5	3.0	3.5	5.0	1.2	3.0	3.5	4.0	2.0	2.0	--	--
		4 mo.	1.5	1.5	1.7	2.0	3.7	4.0	1.0	1.0	5.2	6.0	1.5	2.2	4.5	4.5	2.5	2.5	--	--
		5 mo.	4.5	4.5	2.5	2.5	2.7	3.0	2.0	3.0	7.0	7.0	1.5	2.0	6.0	6.0	2.3	2.3	--	--
		6 mo.	2.2	2.5	1.5	1.7	2.0	2.0	1.5	2.0	3.7	4.0	1.0	1.2	5.0	5.0	2.3	2.3	--	--
9	PHYTAR 12	1 da.	1.2	4.4	2.2	5.7	1.0	1.0	1.0	2.3	1.7	4.8	1.0	1.4	1.0	2.7	1.0	1.5	--	--
		4 da.	3.0	7.0	5.7	9.5	--	--	2.5	5.0	2.7	6.5	1.2	2.5	3.0	7.0	--	--	--	--
		1 wk.	5.0	7.2	7.7	9.2	4.5	5.5	3.3	5.7	4.5	7.7	1.0	2.7	6.5	8.5	1.5	2.0	--	--
		2 wk.	5.0	6.2	6.5	8.0	--	--	4.3	7.7	4.2	6.7	1.3	2.7	7.5	9.0	1.5	3.0	--	--
		1 mo.	6.0	5.7	3.5	4.0	2.0	4.0	4.5	7.0	4.0	5.7	1.5	3.0	--	--	2.0	4.0	--	--
		2 mo.	2.0	2.2	1.2	1.5	3.0	3.5	1.0	1.0	3.5	4.0	1.0	1.7	5.7	4.0	1.0	1.0	--	--
		3 mo.	2.0	3.0	1.5	2.7	3.0	3.2	1.3	2.3	4.0	5.7	1.3	2.0	5.0	5.0	2.0	2.0	--	--
		4 mo.	1.5	1.5	1.7	1.7	4.0	4.0	1.0	1.0	4.0	4.2	1.2	1.7	5.5	5.5	4.5	5.0	--	--
		5 mo.	4.3	4.3	2.0	2.0	2.3	2.3	2.0	3.0	5.8	5.5	1.5	1.8	7.0	7.0	4.0	4.0	--	--
		6 mo.	2.5	2.7	1.2	1.2	1.5	1.5	2.0	3.0	2.7	3.0	1.0	1.0	3.5	3.5	5.0	5.0	--	--

TABLE 13 (Cont.): SERIES I, RAPID DEFOLIANTS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical lb/acre	Period after Treat.	Guava		Lantana		Ohia		Java-plum		Melastoma		Hala		Christmas-berry		Waiwi		Silver Oak	
			V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I
10	PHYTAR 18	1 da.	1.1	3.9	2.6	5.9	1.0	1.0	1.0	2.2	1.7	4.9	1.0	1.4	--	--	1.0	1.7	--	--
		4 da.	1.5	5.0	4.7	8.0	2.0	2.7	1.3	4.3	3.0	6.7	1.0	1.7	--	--	--	--	--	--
		1 wk.	4.2	7.2	7.2	9.5	3.3	5.0	2.2	5.5	3.5	7.0	1.0	2.2	--	--	2.0	3.5	--	--
		2 wk.	5.0	6.2	7.3	8.0	4.0	6.0	4.5	7.0	4.5	8.0	1.2	2.7	--	--	5.0	7.0	--	--
		1 mo.	4.5	5.0	3.0	4.0	3.7	6.3	5.5	7.5	5.0	7.0	1.2	1.5	--	--	--	--	--	--
		2 mo.	2.7	2.5	1.0	1.2	6.2	6.0	2.0	2.0	5.2	5.5	1.0	1.5	--	--	2.5	2.0	--	--
		3 mo.	2.0	3.0	1.5	2.2	4.0	5.0	1.5	3.0	4.2	6.0	1.3	2.7	3.5	4.5	2.5	3.0	--	--
		4 mo.	2.2	2.5	1.5	2.2	4.0	4.0	1.0	2.0	6.5	7.0	1.2	2.2	4.0	4.0	4.0	4.0	--	--
		5 mo.	5.0	5.0	2.8	2.8	2.3	2.8	2.5	3.5	6.5	6.5	1.5	2.0	7.0	7.0	6.0	6.0	--	--
		6 mo.	2.7	3.0	1.5	1.7	2.0	2.5	1.5	2.0	3.5	4.0	1.0	1.2	3.0	3.0	3.0	3.0	--	--
11	Silvex 7	1 wk.	2.2	4.7	2.7	6.0	1.5	2.7	--	--	2.7	5.0	1.0	2.2	3.0	5.0	--	--	--	--
		2 wk.	2.5	5.0	5.5	7.7	2.2	3.5	3.0	6.0	3.7	7.2	1.2	2.5	5.0	7.0	1.0	3.0	--	--
		1 mo.	3.0	4.5	3.7	4.7	2.2	4.0	3.0	5.0	5.5	8.2	1.2	2.5	5.0	9.0	--	--	--	--
		2 mo.	5.0	5.5	1.0	1.0	3.2	3.7	10.0	10.0	9.7	9.7	1.7	2.5	--	--	--	--	--	--
		3 mo.	6.0	6.7	1.5	2.0	3.5	5.0	4.0	6.7	8.5	9.0	2.3	4.3	8.5	9.5	9.0	9.0	--	--
		4 mo.	4.5	5.0	2.5	3.5	4.5	4.5	8.0	8.0	9.0	9.5	4.5	4.7	10.0	10.0	9.5	10.0	--	--
		5 mo.	6.8	6.8	4.5	4.5	3.8	3.8	7.5	7.5	9.3	9.3	3.5	5.3	8.0	8.0	--	--	--	--
		6 mo.	4.0	4.5	1.7	2.0	3.2	4.0	4.5	5.0	8.2	8.2	2.2	3.2	6.2	6.5	5.0	5.5	--	--
		7 mo.	2.5	3.5	2.0	2.0	2.7	4.0	3.0	4.5	--	--	2.0	3.0	9.0	9.0	5.0	5.0	--	--
12	Silvex 14	1 wk.	1.7	4.5	3.5	6.5	1.5	2.7	2.0	4.0	2.2	4.7	2.0	3.0	2.0	3.0	1.0	2.0	--	--
		2 wk.	2.7	4.7	5.5	7.2	3.0	4.5	3.5	6.0	3.2	7.2	2.0	3.5	5.0	5.0	1.5	3.0	--	--
		1 mo.	2.7	4.7	7.0	6.7	2.0	4.0	2.5	7.0	4.5	8.7	1.5	3.0	5.0	8.0	3.0	5.0	--	--
		2 mo.	6.7	7.0	1.0	1.5	4.0	4.7	9.6	10.0	9.5	10.0	1.7	2.3	--	--	--	--	--	--
		3 mo.	5.0	5.5	1.7	2.5	4.0	5.2	8.5	9.0	8.2	9.2	2.7	4.7	8.0	9.0	10.0	10.0	--	--
		4 mo.	4.7	5.0	1.7	2.2	4.5	5.2	9.5	9.5	8.5	9.7	4.7	5.7	10.0	10.0	10.0	10.0	--	--
		5 mo.	7.0	7.0	4.3	4.3	5.3	5.3	9.0	9.0	9.8	9.8	4.5	5.8	10.0	10.0	9.0	9.0	--	--
		6 mo.	5.2	5.7	1.5	2.0	3.5	4.2	9.5	9.0	8.7	9.0	4.0	6.0	5.5	5.5	9.0	9.0	--	--
		7 mo.	3.5	4.0	2.0	2.0	3.7	4.7	7.0	7.0	--	--	2.5	4.0	--	--	8.0	8.0	--	--

TABLE 13 (Cor. .): SERIES I, RAPID DEFOLIANTS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical lb/acre	Period after Treat.	Guava		Lantana		Ohia		Java-plum		Melastoma		Hala		Christmas-berry		Waiwi		Silver Oak	
			V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I
14	HCA + 2, 4, 5-T (6+6)	1 wk.	1.0	3.0	1.7	4.0	1.5	2.5	1.7	4.0	1.5	5.2	1.0	3.0	--	--	1.0	2.5	--	--
		2 wk.	2.7	4.7	5.7	7.0	3.0	4.0	2.5	5.7	5.0	8.0	1.5	3.0	--	--	--	--	--	--
		1 mo.	2.7	4.0	7.5	6.5	2.0	5.0	3.0	5.7	5.7	8.2	1.5	3.0	--	--	4.7	5.3	--	--
		2 mo.	8.0	8.2	1.5	1.7	2.5	3.0	9.7	9.0	10.0	10.0	3.5	6.0	--	--	--	--	--	--
		3 mo.	7.5	8.2	1.7	2.2	4.0	5.0	8.3	8.7	8.3	9.3	2.5	7.0	8.5	9.5	10.0	10.0	--	--
		4 mo.	7.0	7.7	2.2	3.0	4.0	4.0	9.0	9.0	8.3	9.3	2.5	4.5	10.0	10.0	10.0	10.0	--	--
		5 mo.	8.3	8.3	5.3	5.3	3.0	3.5	8.8	8.8	9.3	9.3	6.0	7.0	10.0	10.0	7.8	7.8	--	--
		6 mo.	5.5	5.7	1.7	1.7	3.0	4.0	8.5	8.7	9.0	9.0	3.0	5.0	6.0	6.0	7.7	7.7	--	--
		7 mo.	3.7	4.3	2.0	2.0	3.5	4.0	7.7	7.0	--	--	4.0	5.5	9.0	9.0	5.0	5.0	--	--
15	HCA + 2, 4, 5-T (12+12)	1 wk.	1.2	3.0	2.2	4.5	1.0	2.5	1.3	3.3	2.5	5.5	1.5	2.5	1.5	3.0	1.0	3.5	--	--
		2 wk.	2.0	4.2	6.2	7.5	3.0	4.5	2.3	5.7	4.5	8.2	1.0	2.5	4.5	7.5	--	--	2.5	5.0
		1 mo.	3.7	5.7	8.2	8.7	1.5	3.5	3.0	5.0	6.0	9.2	1.2	1.7	4.0	9.0	10.0	9.0	5.0	7.5
		2 mo.	8.0	7.5	1.5	1.5	2.5	3.0	9.7	9.0	10.0	10.0	6.0	6.0	9.5	10.0	--	--	--	--
		3 mo.	7.7	8.2	2.0	2.7	3.5	5.5	8.2	8.5	7.0	8.7	3.5	7.0	5.0	8.5	10.0	10.0	10.0	10.0
		4 mo.	6.5	7.2	2.2	2.7	4.0	5.5	8.5	9.0	8.5	9.2	2.5	5.5	10.0	10.0	10.0	10.0	9.5	9.5
		5 mo.	7.8	7.8	5.0	5.0	7.5	7.5	9.0	9.0	9.5	9.5	2.3	5.0	10.0	10.0	10.0	10.0	9.0	9.0
		6 mo.	5.7	6.2	1.7	1.7	4.5	5.0	9.0	9.0	9.0	9.0	3.2	5.2	9.5	9.5	7.0	8.0	8.0	8.0
		7 mo.	3.7	4.3	2.0	2.0	4.0	4.0	8.3	7.3	--	--	5.0	5.5	9.5	9.0	--	--	8.0	7.5

TABLE 14: SERIES II, RAPID DEFOLIANTS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical lb/acre	Period after Treat.	Guava		Lantana		Ohia		Java-plum		Melastoma		Waiwi		Christmas-berry		Silver Oak		Rhodo-myrtus	
			Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.
1	Diquat 3	1 da.	1.0	1.5	1.7	3.8	1.0	1.0	1.0	1.2	1.0	1.7	1.0	1.5	1.5	2.5	1.0	1.7	1.0	1.5
		4 da.	1.0	3.0	4.0	6.5	2.3	4.7	1.5	3.0	3.3	8.8	1.3	1.3	4.5	6.5	1.3	1.3	1.0	2.0
		1 wk.	2.5	3.7	5.2	8.0	4.7	6.0	2.5	4.2	4.2	9.0	1.0	1.5	8.5	9.0	1.0	2.7	1.5	3.0
		2 wk.	3.5	5.0	7.5	8.5	5.0	6.5	5.5	7.0	5.2	9.5	1.3	2.7	9.0	9.5	1.7	3.0	2.0	4.0
		1 mo.	5.7	5.5	6.7	6.0	7.0	8.0	6.5	6.5	7.0	9.0	1.7	2.2	9.5	8.5	1.7	2.0	2.5	3.5
		2 mo.	6.0	5.8	4.5	4.3	6.0	6.8	5.3	5.5	8.0	8.5	1.5	2.3	6.0	6.0	1.5	2.5	1.0	1.5
		3 mo.	4.5	5.0	3.2	3.2	5.7	6.5	6.2	7.0	6.5	7.0	2.7	2.7	5.5	5.5	1.2	2.0	1.0	1.5
		4 mo.	2.0	2.0	1.7	1.7	5.5	5.5	2.0	3.2	5.0	6.0	2.3	2.7	2.5	2.0	1.2	1.2	1.0	1.0
2	Diquat 6	1 da.	1.0	1.5	1.7	3.8	1.0	1.0	1.0	1.7	1.0	2.5	1.0	1.3	1.0	2.5	1.0	1.3	1.0	1.5
		4 da.	1.0	3.0	2.7	4.7	1.0	1.0	2.0	4.0	3.7	9.3	1.0	1.3	3.5	5.5	1.0	1.5	1.0	2.0
		1 wk.	2.0	3.5	5.0	7.2	3.0	5.0	2.0	3.0	4.2	9.5	1.0	1.7	8.5	9.0	1.0	2.0	1.5	2.5
		2 wk.	3.7	5.0	7.5	8.5	4.7	6.0	7.0	8.0	5.5	9.5	1.7	3.0	9.0	9.0	2.0	2.5	2.0	4.0
		1 mo.	5.7	5.5	7.0	6.5	5.5	6.5	8.0	8.0	7.2	9.0	2.2	2.7	9.5	9.0	2.7	3.2	2.0	3.0
		2 mo.	5.8	5.5	4.5	4.5	5.5	6.3	5.5	5.8	8.0	8.5	1.8	2.3	6.0	6.0	3.0	3.5	1.5	2.0
		3 mo.	4.5	5.0	4.5	3.5	5.0	5.7	5.2	6.0	5.7	6.0	2.2	2.2	5.5	5.5	3.2	3.7	1.0	1.5
		4 mo.	3.0	3.0	1.7	2.0	5.5	5.5	2.7	4.0	4.3	5.3	2.0	2.0	2.5	2.5	2.2	2.7	1.0	1.0
3	Diquat 9	1 da.	1.0	1.5	2.5	4.8	1.5	1.5	1.3	2.3	1.0	2.5	1.0	1.7	1.0	2.0	1.3	2.5	1.0	1.5
		4 da.	2.0	4.5	4.5	7.5	3.0	5.0	2.0	4.0	4.3	10.0	1.0	1.5	4.0	6.0	1.3	2.8	1.0	2.0
		1 wk.	3.2	5.2	6.0	8.5	3.7	6.0	2.0	4.0	4.0	9.3	1.0	1.7	8.5	8.5	2.5	4.5	1.5	3.5
		2 wk.	5.7	6.5	8.0	9.2	6.7	8.0	7.0	8.0	5.7	9.7	1.7	3.0	9.0	9.0	4.7	5.2	3.5	5.0
		1 mo.	7.2	7.0	7.7	7.0	7.0	7.5	6.0	6.0	7.0	8.7	2.5	3.0	9.5	8.5	4.7	5.5	3.5	4.0
		2 mo.	8.0	7.5	4.8	5.0	6.0	7.0	6.7	7.0	7.8	8.0	2.0	2.8	6.0	6.0	3.3	3.8	2.0	2.5
		3 mo.	5.5	6.0	4.7	5.0	6.0	6.5	6.3	7.0	6.7	7.0	3.0	3.0	5.5	5.5	4.0	4.5	1.5	2.5
		4 mo.	2.7	3.7	2.7	3.2	6.3	6.7	2.2	3.2	5.3	6.0	2.0	2.0	2.5	3.0	1.5	2.0	1.0	1.0

TABLE 14 (Cont.): SERIES II, RAPID DEFOLIANTS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical lb/acre	Period after Treat.	Guava		Lantana		Ohia		Java-plum		Melastoma		Waiwi		Christmas-berry		Silver Oak		Rhodo-myrtus	
			Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.
12	Diquat + PHYTAR 6+6	1 da.	1.0	2.8	4.0	6.5	1.0	1.5	1.0	3.0	3.0	7.3	1.0	3.0	4.0	6.0	1.5	3.5	1.0	2.5
		4 da.	3.8	6.5	4.8	7.5	1.3	3.8	2.0	4.0	3.3	8.8	2.3	4.0	8.0	10.0	2.0	5.0	1.0	3.5
		1 wk.	6.5	7.7	8.7	9.5	5.0	6.7	6.0	6.5	7.0	9.7	3.7	4.3	9.0	10.0	5.5	7.0	4.0	5.5
		2 wk.	8.2	8.2	9.2	8.0	4.0	6.5	5.7	6.3	5.5	8.7	3.0	3.5	9.0	9.5	7.0	7.3	3.5	5.5
		1 mo.	8.2	8.2	8.2	7.5	6.7	7.7	3.5	8.0	7.5	9.2	5.5	5.5	9.5	10.0	7.5	8.0	4.0	5.0
		2 mo.	7.8	7.5	7.8	7.5	8.0	8.7	7.7	7.3	8.3	8.5	5.0	5.0	8.5	8.0	4.3	4.3	4.0	4.5
		3 mo.	5.7	6.0	4.2	4.7	7.3	8.0	7.5	7.5	6.5	6.7	3.0	4.0	3.0	3.0	4.0	5.0	2.5	3.0
		4 mo.	3.2	3.2	2.2	2.7	8.0	8.0	4.7	5.0	6.0	7.0	2.5	3.0	4.0	4.0	2.2	2.5	2.0	3.0
4	PHYTAR 6	1 da.	1.3	2.0	2.5	4.8	--	--	1.3	1.7	1.3	2.5	1.0	1.8	1.5	3.0	1.5	2.3	1.0	2.0
		4 da.	2.0	4.8	6.3	8.5	2.3	4.7	1.5	3.8	4.8	10.0	1.0	1.5	4.0	7.0	1.5	3.8	1.0	2.5
		1 wk.	4.2	5.7	6.5	9.0	2.7	4.7	2.7	5.0	4.5	9.5	1.0	2.0	8.5	9.5	1.7	4.7	1.5	3.0
		2 wk.	5.5	6.2	8.2	8.7	5.0	6.0	4.5	6.0	6.0	9.7	1.7	3.0	9.0	10.0	4.0	4.7	3.5	4.5
		1 mo.	7.5	7.2	8.2	7.2	5.2	6.2	5.2	5.2	7.2	9.0	2.7	3.0	9.5	9.0	5.0	5.5	3.0	3.5
		2 mo.	7.0	7.0	5.3	5.3	5.8	6.8	6.0	6.0	8.3	8.8	2.5	2.8	6.5	6.5	4.0	4.5	2.0	2.5
		3 mo.	5.2	5.5	4.5	4.5	5.7	6.0	5.5	5.7	6.7	6.7	2.7	3.2	5.0	5.5	4.0	4.4	1.0	2.0
		4 mo.	2.7	3.0	2.5	2.5	5.5	5.5	2.7	3.7	4.7	5.2	2.0	2.5	2.5	3.0	2.7	3.0	1.0	1.0
6	PHYTAR 9	1 da.	1.3	2.0	1.8	3.3	1.0	1.0	1.0	1.8	1.0	1.8	1.0	1.3	1.0	2.0	1.0	1.8	1.0	2.0
		4 da.	2.0	4.8	8.5	8.5	1.5	1.7	1.5	4.8	2.5	6.3	1.0	2.0	4.0	5.5	1.3	3.3	1.0	3.0
		1 wk.	3.7	6.0	8.5	9.0	1.5	2.0	2.7	4.7	3.7	7.7	1.2	2.2	9.0	9.0	1.3	2.7	1.5	3.5
		2 wk.	4.2	4.7	8.7	8.7	2.7	3.7	4.0	4.7	4.0	6.0	3.0	3.7	9.0	9.0	2.2	3.2	3.0	4.0
		1 mo.	5.5	6.7	8.7	7.7	4.0	5.0	4.7	5.0	5.5	7.2	3.5	3.7	9.5	9.0	4.0	4.0	3.0	3.5
		2 mo.	6.8	6.5	7.8	7.8	4.3	4.3	4.8	5.0	5.0	5.3	3.5	3.8	8.0	8.0	3.5	3.8	1.5	2.0
		3 mo.	5.5	5.5	4.7	4.7	4.0	4.3	5.5	6.0	5.0	5.0	2.7	3.2	8.0	8.0	3.7	3.7	1.0	2.0
		4 mo.	2.2	2.2	2.2	2.5	3.7	4.0	2.7	4.0	4.2	5.2	2.0	2.0	2.0	2.5	3.0	3.5	1.0	1.0

TABLE 14 (Cont.): SERIES II, RAPID DEFOLIANTS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical lb/acre	Pericd after Treat.	Guava		Lantana		Ohia		Java-plum		Melastoma		Waiwi		Christmas-berry		Silver Oak		Rhodo-myrtus	
			Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.
5	PHYTAR 12	1 da.	1.3	2.3	2.8	4.3	1.0	1.0	1.5	2.5	1.3	2.5	1.3	2.3	1.5	2.0	--	--	1.0	2.0
		4 da.	2.0	4.5	7.3	9.3	2.5	5.0	1.8	4.5	3.3	8.0	1.0	2.8	4.0	6 5	1.0	3.5	1.0	3.0
		1 wk.	4.2	6.0	7.5	9.0	--	--	2.5	4.5	4.5	8.7	1.7	2.7	9.0	9.0	1.5	4.0	1.5	3.5
		2 wk.	6.2	6.5	9.2	9.2	3.5	4.5	5.0	6.0	6.0	9.2	4.5	5.2	9.0	9.5	3.5	4.5	4.0	5.5
		1 mo.	7.5	7.0	9.0	8.5	4.0	4.5	6.0	6.2	7.2	9.0	5.0	5.0	9.5	9.0	4.0	4.5	4.0	4.5
		2 mo.	7.0	6.8	6.8	6.8	4.5	4.5	6.0	6.3	7.3	8.0	3.0	3.5	7.0	7.0	4.0	4.5	1.5	2.0
		3 mo.	5.5	5.7	4.7	4.7	3.5	3.5	5.7	6.0	6.7	7.0	3.5	3.7	8.0	8.5	4.0	4.0	1.0	2.0
		4 mc.	2.5	3.2	3.0	3.2	2.5	2.5	2.7	4.0	5.3	6.0	2.0	2.0	2.0	2.5	2.5	3.5	1.0	1.0
7	PHYTAR 15	1 da.	1.3	2.3	1.5	3.0	1.0	1.0	1.3	1.7	1.0	2.0	1.0	1.3	1.0	2.0	--	--	1.0	2.0
		4 da.	2.0	4.5	8.8	8.8	1.0	1.0	1.5	5.5	3.8	6.3	1.0	2.5	3.0	5.0	3.0	6.0	1.0	3.5
		1 wk.	3.0	6.0	8.2	8.7	3.0	4.0	2.5	4.7	4.0	7.7	1.0	2.5	8.5	8.5	--	--	1.5	4.0
		2 wk.	5.0	6.0	9.7	9.7	3.5	4.5	5.0	6.0	6.0	8.0	2.2	3.0	9.5	9.5	6.5	8.0	3.5	4.5
		1 mo.	5.7	6.5	9.2	8.7	3.5	4.2	5.7	6.0	5.7	6.7	2.7	3.2	9.5	9.0	7.0	8.0	4.0	4.5
		2 mo.	6.8	6.8	8.8	8.3	4.3	5.0	5.5	5.8	6.3	6.8	2.8	3.0	8.0	8.0	6.5	6.5	2.0	2.5
		3 mo.	6.0	6.0	5.2	5.2	5.0	5.2	5.5	6.2	4.7	4.7	3.0	3.2	6.5	6.5	5.0	6.0	1.0	2.0
		4 mo.	1.7	2.2	2.7	3.0	3.0	3.0	2.5	3.5	4.5	5.5	2.0	2.0	4.0	4.0	2.0	2.0	1.0	1.5
8	Pentachloro-phenol 6	1 da.	1.5	2.5	2.5	5.0	1.0	1.0	1.5	2.0	1.3	2.8	1.3	2.8	1.0	3.0	--	--	1.0	2.0
		4 da.	2.3	4.3	7.5	8.0	1.3	1.7	1.3	4.7	4.0	6.7	1.0	2.5	4.5	8.5	1.0	3.0	1.0	2.5
		1 wk.	3.2	5.7	7.2	8.7	2.5	4.0	2.0	4.0	3.5	7.0	1.0	2.2	8.5	8.0	--	--	1.5	4.0
		2 wk.	5.0	6.0	8.0	8.0	3.5	4.0	4.7	5.5	5.7	8.2	3.0	3.5	9.5	10.0	6.0	6.0	4.0	4.5
		1 mo.	7.0	7.2	8.2	7.5	4.0	4.7	5.2	5.5	6.2	7.2	3.2	3.7	9.5	9.0	7.0	7.0	4.0	4.5
		2 mo.	6.3	6.5	7.0	7.0	4.3	4.3	5.5	5.8	6.7	6.7	2.8	3.3	6.5	6.5	4.5	4.5	1.5	2.5
		3 mo.	5.7	6.0	4.7	4.7	4.0	4.7	5.5	6.2	6.5	6.5	3.2	3.7	5.0	5.0	1.0	1.0	2.5	2.5
		4 mo.	2.2	3.0	2.0	2.2	2.3	2.7	2.7	3.7	5.7	7.0	2.0	2.2	3.5	4.0	2.0	2.0	1.0	1.5

TABLE 14 (Cont.): SERIES II, RAPID DEFOLIANTS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical lb/acre	Period after Treat.	Guava		Lantana		Ohia		Java-plum		Melastoma		Waiwi		Christmas-berry		Silver Oak		Rhodo-myrtus	
			Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.
9	Pentachlorophenol 12L	1 da.	1.8	3.3	2.0	4.3	1.3	2.7	1.5	2.8	1.5	2.8	1.3	3.0	1.5	3.5	1.3	3.0	1.5	2.0
		4 da.	2.3	5.8	6.8	8.5	1.3	2.7	1.5	4.8	2.5	5.5	1.3	3.0	3.0	9.0	1.3	3.0	1.0	2.5
		1 wk.	3.7	6.7	7.0	8.5	3.0	4.0	2.3	4.7	4.3	7.7	1.3	2.7	6.5	9.5	1.0	2.5	1.5	4.0
		2 wk.	5.7	7.0	8.5	8.7	4.0	5.0	4.2	5.0	5.2	8.0	3.7	4.5	9.5	10.0	3.5	4.2	3.0	4.0
		1 mo.	6.2	6.5	6.7	6.0	4.2	5.0	5.0	5.2	5.5	6.2	4.7	5.0	9.5	8.5	4.0	4.3	3.0	4.0
		2 mo.	6.5	6.5	6.5	6.5	4.3	4.8	5.8	6.0	5.5	5.8	4.0	4.0	6.5	6.5	4.7	5.0	1.5	2.5
		3 mo.	5.7	6.0	4.2	4.2	3.3	3.7	5.2	5.5	5.0	5.0	4.2	4.2	5.5	5.5	2.7	3.3	1.5	2.0
		4 mo.	2.0	2.2	3.5	4.2	2.3	2.7	2.3	3.3	4.5	5.5	4.0	4.0	3.0	3.5	2.0	2.0	1.0	1.5
10	Pentachlorophenol 12H	1 da.	1.5	3.5	4.3	6.5	1.5	2.5	1.3	2.8	2.0	5.5	1.3	2.8	7.0	8.5	--	--	1.3	2.5
		4 da.	3.3	6.8	6.0	8.8	1.8	4.3	2.0	5.5	3.0	7.8	2.8	5.8	8.0	9.5	1.0	3.0	1.0	3.5
		1 wk.	7.2	8.2	9.0	8.7	3.7	5.0	4.5	4.5	5.7	9.0	4.7	6.5	9.5	9.5	3.0	3.5	3.5	4.5
		2 wk.	8.7	9.0	8.5	7.2	3.2	6.0	5.0	6.2	5.0	8.2	3.7	4.7	9.5	9.5	--	--	2.5	4.5
		1 mo.	7.7	7.7	8.7	8.0	4.7	5.2	6.7	6.7	5.5	7.0	6.5	6.7	9.5	9.0	5.5	5.5	3.5	4.0
		2 mo.	6.5	6.5	7.3	7.0	5.3	5.8	7.0	6.8	6.5	6.8	4.7	4.7	7.0	7.0	4.0	4.0	1.5	2.5
		3 mo.	5.5	5.5	5.7	5.2	4.2	4.5	5.5	6.0	5.7	6.0	4.2	4.0	5.5	5.5	2.5	3.0	2.0	2.5
		4 mo.	3.0	3.7	3.5	4.2	3.7	3.7	2.2	3.2	5.3	6.7	2.7	2.7	3.5	4.5	--	--	1.5	2.0
11	Pentachlorophenol 18	1 da.	2.8	5.5	3.8	7.3	2.0	3.5	1.3	3.3	3.3	7.0	2.5	4.5	6.5	8.5	--	--	1.0	2.0
		4 da.	4.0	8.0	4.8	8.5	2.5	5.0	2.3	5.3	4.5	9.3	3.7	7.0	7.0	9.5	1.0	3.0	1.0	3.0
		1 wk.	7.7	8.7	8.7	9.5	5.5	7.5	4.5	5.2	7.0	9.5	6.2	8.0	9.5	10.0	5.0	5.0	4.0	5.5
		2 wk.	8.7	9.0	7.2	7.2	5.0	7.5	5.0	6.0	5.5	9.0	5.2	6.0	9.0	9.5	--	--	3.0	6.0
		1 mo.	7.7	7.7	6.7	6.2	7.0	8.0	6.3	6.7	7.5	8.5	7.0	6.7	9.5	10.0	7.0	7.0	4.0	5.0
		2 mo.	6.8	6.8	7.5	7.3	8.5	8.5	6.8	6.8	8.0	8.0	5.3	5.3	7.0	7.0	4.0	4.0	2.5	3.5
		3 mo.	5.7	5.7	4.2	4.2	6.0	6.5	6.2	6.7	6.5	6.7	4.5	4.5	6.0	6.0	3.3	3.7	2.5	3.0
		4 mo.	3.2	3.2	2.7	3.0	5.5	5.0	2.0	3.3	5.0	5.7	2.5	2.5	3.0	3.5	--	--	1.5	2.0

TABLE 14 (Cont.): SERIES II, RAPID DEFOLIANTS
VISIBILITY AN D INJURY RATINGS

Treat. No.	Chemical lb/acre		Period after Treat.	Guava		Lantana		Ohia		Java-plum		Melastoma		Waiwi		Christmas-berry		Silver Oak		Rhodo-myrtus	
				Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.	Vis.	Inj.
13	AP-20	6	1 da.	1.0	1.8	1.0	2.0	1.0	1.0	1.0	1.0	1.3	2.3	1.0	1.5	--	--	1.0	2.0	1.0	1.5
			4 da.	1.0	1.5	1.5	2.0	1.0	1.3	1.0	2.5	3.0	4.3	1.0	2.7	3.0	4.0	1.0	1.7	1.0	3.5
			1 wk.	1.5	3.0	1.5	2.7	1.0	1.5	1.5	3.0	3.5	4.2	2.5	3.2	3.5	5.0	1.5	2.5	2.5	3.5
			2 wk.	2.0	3.5	2.2	3.2	1.0	1.7	2.0	3.0	2.7	4.3	1.2	1.7	5.0	6.0	2.3	3.7	2.0	3.0
			1 mo.	2.5	3.0	2.2	2.5	1.2	2.0	3.0	3.0	4.2	4.5	3.2	3.2	4.5	5.0	2.3	2.3	1.5	3.0
			2 mo.	4.0	4.5	3.8	3.8	1.0	1.3	2.7	3.7	3.3	3.5	2.3	3.3	6.0	6.0	2.5	2.5	1.5	2.0
			3 mo.	4.7	4.7	3.5	3.7	1.2	1.2	3.7	4.0	4.7	4.7	3.3	4.0	5.0	5.0	2.3	2.7	1.0	2.0
			4 mo.	3.0	3.7	1.5	1.7	1.0	1.3	--	--	3.7	5.0	1.5	1.5	3.0	3.0	1.0	1.5	1.0	1.0
14	AP-20	12	1 da.	1.0	2.3	1.0	2.5	1.0	1.3	1.0	1.7	1.3	2.0	1.0	1.3	3.5	5.5	--	--	1.0	1.5
			4 da.	1.8	3.8	1.8	3.0	1.0	2.3	1.5	3.0	2.0	4.0	1.7	3.7	9.0	9.0	--	--	1.0	3.0
			1 wk.	2.5	3.7	2.7	4.0	2.2	3.2	3.5	4.5	3.5	5.0	2.7	4.3	10.0	10.0	4.0	5.0	3.0	4.0
			2 wk.	3.2	5.0	3.0	3.7	2.0	3.3	3.3	5.0	2.0	3.0	2.7	3.3	10.0	10.0	5.0	5.0	1.0	3.0
			1 mo.	3.2	3.7	3.7	3.7	2.7	2.7	4.0	4.3	3.5	4.7	4.7	4.7	7.5	7.5	5.0	5.0	1.5	3.0
			2 mo.	5.8	6.3	4.0	4.0	2.5	2.5	6.0	6.3	3.8	4.0	3.3	3.7	7.0	6.5	4.0	4.0	1.5	2.0
			3 mo.	5.7	6.0	4.2	4.5	1.5	2.0	6.2	6.2	4.5	4.7	3.2	3.7	5.0	5.0	5.0	5.0	1.0	2.0
			4 mo.	3.2	3.2	2.2	2.0	2.0	2.0	2.7	3.7	3.7	4.0	2.3	2.3	3.0	3.0	3.0	5.0	1.0	1.0

TABLE 15: SERIES III, RAPID DEFOLIANT-SYSTEMIC COMBINATIONS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia		Melastoma		Lantana		Guava		Kalia		Atea		Ohia Ha		Tree Fern		False Staghorn Injury
			V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	
1	ORANGE (M3151)	4 da.	1.0	2.5	1.5	4.0	2.0	5.5	1.5	3.0	1.5	6.5	1.0	2.5	1.0	1.0	1.0	3.0	4.0
	12	2 wk.	2.0	4.5	3.0	8.0	5.0	9.0	3.0	6.5	1.0	4.0	2.0	6.0	2.0	3.0	1.0	3.0	7.5
		4 wk.	2.3	5.0	7.0	9.0	9.5	9.5	7.0	8.0	7.0	10.0	5.0	7.0	4.0	5.0	3.0	5.0	8.0
		6 wk.	4.0	6.5	8.5	9.0	9.5	8.5	8.0	9.7	10.0	10.0	6.5	9.0	4.0	6.5	5.0	7.0	9.0
		2 mo.	5.5	7.5	9.0	10.0	7.5	7.5	8.5	9.5	10.0	10.0	10.0	10.0	6.0	7.0	2.5	4.0	9.0
		3 mo.	6.5	7.5	10.0	10.0	3.0	3.0	9.5	9.5	10.0	10.0	10.0	10.0	4.0	5.0	1.5	2.0	9.5
		4 mo.	7.5	8.0	9.5	9.0	5.0	5.0	10.0	10.0	10.0	10.0	10.0	10.0	4.0	4.0	2.5	2.5	9.5
2	ORANGE + PCP	4 da.	1.0	3.0	2.0	5.5	1.5	6.0	2.5	4.5	1.0	5.0	1.0	3.0	1.0	1.0	1.0	3.0	4.0
	12 + 12	2 wk.	2.5	5.5	3.0	8.0	5.0	9.0	4.0	7.0	4.0	8.0	2.5	7.0	2.0	3.0	1.0	7.0	8.0
		4 wk.	3.7	5.3	7.3	9.3	9.0	9.5	8.3	9.0	9.0	10.0	5.5	8.0	1.0	3.0	3.0	5.3	8.3
		6 wk.	5.0	7.5	8.0	9.0	9.5	8.5	8.5	10.0	10.0	10.0	9.0	10.0	4.0	7.0	3.3	4.0	9.0
		2 mo.	6.0	8.0	9.0	10.0	7.5	7.5	9.5	9.5	10.0	10.0	8.0	10.0	6.0	7.0	2.5	5.5	9.0
		3 mo.	7.0	8.0	10.0	10.0	3.0	3.0	9.5	9.5	10.0	10.0	10.0	10.0	4.0	5.0	1.0	1.0	9.5
		4 mo.	7.5	8.0	9.5	8.5	5.0	5.0	10.0	10.0	10.0	10.0	10.0	10.0	4.0	4.0	1.0	1.0	10.0
3	ORANGE + DNBP	4 da.	1.5	3.5	2.0	8.0	2.0	7.0	2.5	5.0	1.5	8.5	1.5	7.0	1.0	2.0	--	--	6.0
	12 + 7.5	2 wk.	2.5	6.0	4.5	9.0	5.0	9.0	4.0	7.5	3.0	10.0	3.0	9.5	1.0	5.0	3.0	9.0	8.0
		4 wk.	4.7	7.0	7.3	9.3	9.3	9.0	8.0	9.5	7.0	10.0	7.0	9.5	3.0	4.0	5.0	7.0	9.3
		6 wk.	6.0	8.5	8.5	9.0	8.5	8.0	9.0	10.0	10.0	10.0	10.0	10.0	3.0	6.0	--	--	9.0
		2 mo.	7.0	8.5	9.0	10.0	8.0	8.0	10.0	10.0	10.0	10.0	10.0	10.0	6.0	7.0	--	--	9.5
		3 mo.	7.5	8.5	9.5	9.5	3.0	3.0	10.0	10.0	10.0	10.0	10.0	10.0	7.0	8.0	--	--	9.5
		4 mo.	8.0	8.5	9.5	8.5	5.5	5.5	10.0	10.0	10.0	10.0	10.0	10.0	7.0	7.0	5.0	7.0	10.0

TABLE 15 (Cont.): SERIES III, RAPID DEFOLIANT-SYSTEMIC COMBINATIONS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia V	Ohia I	Melastoma V	Melastoma I	Lantana V	Lantana I	Guava V	Guava I	Kalia V	Kalia I	Aica V	Aica I	Ohia Ha V	Ohia Ha I	Tree Fern V	Tree Fern I	False Staghorn Injury
4	ORANGE + DNBP 8 + 12	4 da.	1.5	3.0	2.0	8.5	2.5	7.5	2.5	6.0	1.5	6.5	1.5	6.0	--	--	--	--	5.5
		2 wk.	3.5	5.5	4.5	8.5	3.0	9.0	4.0	7.5	2.0	9.0	3.0	7.0	2.0	5.0	--	--	8.0
		4 wk.	4.5	7.0	7.3	9.3	10.0	9.7	8.3	9.3	8.0	10.0	5.5	7.0	1.0	3.0	--	--	9.0
		6 wk.	4.5	7.0	8.0	9.0	9.0	8.0	9.0	9.0	--	--	9.0	10.0	4.0	6.0	--	--	9.0
		2 mo.	7.0	8.5	9.0	10.0	8.0	8.0	10.0	10.0	10.0	10.0	9.0	9.0	6.0	7.0	2.0	3.0	9.5
		3 mo.	6.5	7.0	10.0	9.5	4.5	4.5	10.0	10.0	10.0	10.0	10.0	10.0	7.0	9.0	--	--	10.0
		4 mo.	8.5	8.5	9.5	8.5	6.0	6.0	9.0	9.0	10.0	10.0	10.0	10.0	7.0	7.0	--	--	10.0
5	ORANGE + PHYTAR + L-251 12+6	4 da.	1.0	3.5	2.5	7.0	3.5	8.0	2.0	3.5	1.0	3.0	1.0	4.0	1.0	2.0	1.0	2.0	3.5
		2 wk.	2.0	4.0	3.5	7.0	6.5	9.5	5.0	7.0	2.0	9.0	2.0	7.0	--	--	1.0	5.0	5.5
		4 wk.	4.0	6.7	6.0	9.3	10.0	9.3	8.0	9.0	4.0	10.0	5.0	9.0	4.0	5.0	3.0	5.0	9.0
		6 wk.	5.5	7.5	8.0	9.0	9.0	8.0	8.5	9.5	7.0	10.0	9.0	10.0	4.0	6.0	3.5	4.0	9.0
		2 mo.	6.5	8.0	9.0	10.0	7.5	7.5	10.0	10.0	10.0	10.0	10.0	10.0	8.0	9.0	2.0	3.5	9.0
		3 mo.	6.0	6.5	10.0	10.0	3.5	3.5	10.0	10.0	10.0	10.0	10.0	10.0	9.0	9.0	1.0	1.0	10.0
		4 mo.	8.0	8.0	9.5	8.5	7.0	6.0	10.0	10.0	10.0	10.0	9.0	9.0	7.0	7.0	2.0	3.0	9.5
6	PCP + Propanil (CI-99) 6 + 6	4 da.	1.0	2.0	1.5	5.0	2.0	5.5	--	--	1.0	3.5	1.0	3.0	1.0	2.0	1.0	5.5	3.5
		2 wk.	2.5	5.5	4.5	7.5	5.5	9.0	5.0	3.0	3.0	8.0	3.5	6.0	2.0	3.0	1.0	7.0	7.5
		4 wk.	4.3	7.7	5.0	8.3	8.3	9.0	8.0	9.0	9.0	10.0	7.0	8.0	3.0	5.0	5.0	7.5	8.3
		6 wk.	5.0	6.5	8.0	9.0	7.0	6.5	8.0	8.0	10.0	10.0	9.0	10.0	6.0	9.0	3.5	4.3	8.0
		2 mo.	5.0	6.5	7.0	8.0	7.0	7.0	8.0	8.0	10.0	10.0	9.5	10.0	4.0	5.5	3.0	6.0	9.0
		3 mo.	4.0	5.5	9.0	9.0	3.0	3.0	10.0	10.0	10.0	10.0	10.0	10.0	5.0	6.0	3.0	4.0	9.5
		4 mo.	5.0	5.0	9.0	8.0	2.5	2.0	6.0	6.0	10.0	10.0	10.0	10.0	9.0	9.0	3.0	3.0	8.5

TABLE 15 (Cont.): SERIES III, RAPID DEFOLIANT-SYSTEMIC COMBINATIONS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia		Melastoma		Lantana		Guava		Kalia		Aiea		Ohia 'ha		Tree Fern		False Staghorn Injury
			V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	
7	PCP + Propanil (CI-99) 12 + 12	4 da.	1.0	4.0	1.5	6.0	1.5	5.0	3.0	5.0	1.0	3.0	1.0	3.0	1.0	6.0	1.0	3.0	4.0
		2 wk.	3.5	6.5	3.5	7.5	5.0	8.0	7.0	9.0	2.5	7.5	--	--	1.0	3.0	2.0	5.0	8.0
		4 wk.	5.7	7.3	5.3	8.3	7.7	7.7	3.5	5.0	7.0	8.0	7.0	8.0	1.0	2.0	1.0	7.0	7.5
		6 wk.	6.5	7.5	7.0	8.5	6.0	6.5	6.5	6.0	--	--	--	--	--	--	1.7	2.7	7.0
		2 mo.	7.0	8.5	6.0	7.5	7.0	7.0	4.0	5.0	9.0	9.0	--	--	--	--	2.0	3.0	8.0
		3 mo.	4.0	5.5	8.5	8.5	3.0	3.0	10.0	10.0	8.0	8.0	--	--	--	--	2.0	2.5	8.5
		4 mo.	3.5	3.5	8.5	7.0	2.0	2.0	8.0	8.0	8.0	7.0	--	--	--	--	1.0	1.0	7.0
8 +	PCP + PHYTAR +L-251 + L-249 6 + 6	4 da.	1.0	3.0	1.5	4.5	2.5	7.5	1.5	2.5	1.0	4.0	1.0	1.0	--	--	1.0	6.0	3.0
		2 wk.	3.5	6.0	3.5	7.5	5.0	8.5	3.0	7.0	2.0	9.0	2.0	3.5	--	--	2.0	7.0	4.5
		4 wk.	4.7	6.3	5.0	7.7	8.0	8.0	9.0	9.0	6.0	9.0	5.0	6.0	--	--	2.0	6.0	7.3
		6 wk.	6.0	6.5	8.0	8.5	4.5	6.0	8.5	8.0	10.0	10.0	6.0	7.0	--	--	1.0	1.0	7.5
		2 mo.	5.0	6.5	5.0	6.5	5.5	5.5	3.0	3.0	10.0	10.0	7.0	8.0	2.0	3.0	2.0	4.0	5.5
		3 mo.	4.0	4.5	7.5	7.5	2.5	2.5	8.0	8.0	10.0	10.0	8.0	8.0	2.0	3.0	1.0	1.0	6.0
		4 mo.	4.0	4.5	8.5	8.0	1.5	1.5	4.0	4.0	10.0	10.0	7.0	5.0	1.0	1.0	1.0	1.0	1.0
9	DES-I-CATE 3	4 da.	1.0	2.5	1.5	4.5	2.5	7.5	1.0	3.0	--	--	1.0	1.5	--	--	1.0	6.0	2.5
		2 wk.	4.5	5.5	4.0	7.0	5.5	9.0	3.0	5.0	--	--	1.5	3.0	--	--	8.0	10.0	6.5
		4 wk.	3.7	5.0	5.0	7.7	8.7	8.0	7.0	7.0	--	--	4.0	5.0	1.0	3.0	5.5	6.5	6.7
		6 wk.	3.0	4.0	8.0	7.0	4.0	5.0	5.3	6.0	--	--	5.0	6.0	--	--	3.0	5.0	6.5
		2 mo.	6.5	7.5	5.0	6.5	6.5	5.5	2.0	3.0	--	--	3.0	3.5	--	--	4.0	5.0	7.5
		3 mo.	2.5	4.0	5.0	5.0	1.5	1.5	2.0	3.0	2.0	2.0	3.5	4.0	--	--	1.0	1.0	4.5
		4 mo.	2.0	2.0	5.0	5.0	1.5	1.5	2.0	2.0	--	--	2.0	2.0	--	--	1.0	1.0	4.5

TABLE 15 (Cont.): SERIES III, RAPID DEFOLIANT-SYSTEMIC COMBINATIONS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia		Melastoma		Lantana		Guava		Kalia		Aiea		Ohia Ha		Tree Fern		False Staghorn Injury
			V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	
10	DES-I-CATE+	4 da.	1.0	2.5	2.0	7.0	2.0	7.0	1.0	3.0	--	--	1.0	2.0	--	--	--	--	4.5
	Paraquat 3+1	2 wk.	4.0	6.0	4.5	8.0	5.5	9.0	5.0	7.0	--	--	2.0	4.0	7.0	8.0	--	--	7.0
		4 wk.	4.7	5.7	6.0	9.0	8.3	8.3	7.0	7.5	--	--	--	--	7.0	8.0	5.0	6.0	6.7
		6 wk.	4.5	5.0	8.5	7.5	4.0	5.0	2.5	4.0	--	--	10.0	10.0	5.5	7.0	1.7	2.3	8.0
		2 mo.	6.0	7.0	8.0	9.0	7.0	7.0	2.0	3.0	--	--	10.0	10.0	8.0	8.0	2.0	3.0	8.0
		3 mo.	3.0	4.5	8.5	8.5	1.5	1.5	2.0	2.0	6.0	6.0	10.0	10.0	8.0	9.0	2.0	3.0	5.5
		4 mo.	3.0	2.5	8.5	8.0	1.5	1.5	2.0	2.0	10.0	10.0	5.0	7.0	6.0	6.0	1.0	1.0	5.0
11	DES-I-CATE+	4 da.	1.0	4.0	1.5	6.0	3.0	6.5	1.0	3.0	--	--	1.0	3.5	1.0	5.0	--	--	5.0
	Paraquat 1+3	2 wk.	4.0	7.0	4.5	8.5	6.0	7.5	5.0	8.0	--	--	3.0	7.0	--	--	1.5	3.0	7.5
		4 wk.	6.0	7.3	6.0	9.3	8.0	8.0	7.0	8.0	--	--	8.0	9.0	5.0	7.0	2.5	6.0	7.7
		6 wk.	6.0	7.5	8.5	9.0	8.0	8.0	6.0	6.7	--	--	9.5	10.0	7.5	7.5	4.0	5.7	8.0
		2 mo.	7.0	8.0	8.0	9.0	8.0	8.0	8.0	8.0	--	--	9.0	9.5	8.0	8.0	2.0	3.0	7.5
		3 mo.	7.0	8.0	10.0	10.0	4.0	4.0	4.0	4.0	--	--	10.0	10.0	6.0	7.0	2.0	3.0	7.5
		4 mo.	7.5	7.5	9.5	8.0	2.0	2.0	2.0	2.0	--	--	9.5	9.5	6.0	6.0	1.5	2.0	5.0
12	DES-I-CATE+	4 da.	1.0	3.5	1.0	3.0	2.5	7.0	1.0	5.0	1.0	1.0	1.0	2.0	1.0	1.5	1.0	3.0	4.0
	ORANGE 2+8	2 wk.	3.0	4.5	3.5	7.5	5.5	8.5	3.5	5.5	--	--	--	--	--	--	1.0	6.0	6.5
		4 wk.	3.0	4.7	6.3	8.7	9.3	9.0	7.3	8.0	--	--	--	--	2.5	4.5	3.0	4.7	8.0
		6 wk.	5.5	6.5	8.5	9.0	8.5	7.5	5.5	7.5	9.0	10.0	10.0	10.0	5.0	6.0	2.7	5.0	9.0
		2 mo.	6.0	7.0	7.5	8.5	8.0	8.0	8.5	9.5	--	--	--	--	5.0	6.5	1.5	2.5	9.0
		3 mo.	6.0	7.5	9.5	9.5	2.5	2.5	8.0	8.0	--	--	--	--	8.0	8.0	2.0	3.0	8.5
		4 mo.	6.5	7.0	9.5	8.0	2.0	2.0	7.0	7.0	--	--	--	--	7.0	7.0	1.0	1.0	9.0

TABLE 15 (Cont.): SERIES III, RAPID DEFOLIANT-SYSTEMIC COMBINATIONS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia		Melastoma		Lantana		Guava		Kalia		Aiea		Ohia Ha		Tree Fern		False Staghorn Injury
			V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	
13	AP-20 + ORANGE 6 + 12	4 da.	1.0	3.0	3.0	7.0	3.5	7.0	1.0	3.0	--	--	1.0	2.0	1.0	2.0	1.0	3.0	3.5
		2 wk.	2.5	6.0	5.0	8.5	6.0	9.5	3.0	5.5	--	--	1.0	3.0	1.0	3.0	--	--	6.5
		4 wk.	4.7	6.3	6.7	9.3	10.0	9.3	7.0	8.0	--	--	3.0	8.0	3.0	4.0	2.7	5.3	8.0
		6 wk.	5.5	7.5	8.5	9.0	9.0	8.5	9.0	9.5	--	--	5.0	7.0	5.0	6.0	3.0	5.0	8.5
		2 mo.	6.0	7.5	9.0	10.0	8.0	8.0	8.0	9.5	--	--	5.0	8.0	4.0	5.0	1.5	2.0	9.0
		3 mo.	7.5	8.5	8.5	8.5	3.0	4.0	9.0	9.0	--	--	6.0	8.0	5.0	6.0	2.0	3.0	7.5
		4 mo.	8.0	8.0	7.0	7.0	2.0	2.0	8.0	8.0	--	--	10.0	9.0	5.5	5.5	1.0	1.0	9.0
14	AP-20 + PHYTAR + X-77 6 + 6	4 da.	1.0	3.5	2.0	5.5	2.5	7.5	1.0	2.5	1.0	2.5	1.0	1.0	1.0	3.0	--	--	4.0
		2 wk.	3.0	4.5	3.5	7.0	4.0	8.0	3.5	6.0	1.0	6.0	1.0	3.0	2.5	5.5	1.0	2.5	4.0
		4 wk.	3.0	5.0	5.7	8.3	9.0	9.0	6.3	7.7	3.0	6.5	3.0	4.0	3.5	7.0	3.0	6.5	6.7
		6 wk.	5.5	6.5	8.0	8.5	6.5	6.5	6.5	7.5	8.0	10.0	2.0	3.0	6.0	7.0	2.0	4.0	8.0
		2 mo.	5.0	6.0	7.5	9.0	7.0	7.0	7.0	8.5	10.0	10.0	2.0	3.0	5.5	6.5	2.0	3.0	8.0
		3 mo.	4.5	5.0	7.0	7.0	2.5	2.5	9.0	9.0	10.0	10.0	2.3	3.0	3.0	3.5	2.0	3.0	6.5
		4 mo.	4.5	5.5	7.0	7.0	2.0	2.0	7.0	7.0	10.0	10.0	2.0	3.0	5.0	5.0	1.0	1.0	7.5

TABLE 16: SERIES IV H, SYSTEMICS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia V	Ohia I	Melastoma V	Melastoma I	Lantana V	Lantana I	Waiwi V	Waiwi I	Guava V	Guava I	Aiea V	Aiea I	Ohia Ha V	Ohia Ha I	Tree Fern V	Tree Fern I	False Staghorn Injury
1	TORDON 101	1 wk.	1.0	1.0	1.8	3.0	2.0	3.0	--	--	--	--	1.0	1.0	--	--	1.0	1.5	3.0
	(M2628) 1.5 + 6	3 wk.	1.0	3.0	5.0	8.0	1.0	1.0	--	--	--	--	1.0	2.0	--	--	1.0	3.0	7.5
		1 mo.	2.0	3.5	7.0	10.0	1.0	2.0	--	--	--	--	1.0	2.5	--	--	--	--	8.0
		2 mo.	6.0	7.0	8.5	9.5	10.0	0.0	--	--	--	--	1.0	2.0	--	--	--	4.0	8.5
		3 mo.	6.0	6.7	9.0	8.7	10.0	9.7	--	--	--	--	3.5	5.0	--	--	3.0	4.0	8.7
		4 mo.	8.0	8.0	10.0	10.0	8.0	8.0	--	--	--	--	7.0	7.0	--	--	2.0	2.0	8.0
		5 mo.	7.5	7.5	10.0	10.0	5.0	5.0	--	--	--	--	3.0	3.5	--	--	1.0	3.0	9.0
		6 mo.	7.5	7.5	10.0	9.5	2.0	2.0	--	--	--	--	3.0	3.0	--	--	1.0	2.0	9.5
2	TORDON 101	1 wk.	1.0	1.0	1.8	3.0	1.5	1.5	--	--	--	--	1.0	2.0	--	--	1.0	1.5	3.0
	(M2628) 3 + 12	3 wk.	1.0	3.0	6.0	8.5	--	--	--	--	--	--	1.0	2.0	--	--	1.0	3.5	7.5
		1 mo.	1.5	3.5	7.5	9.0	6.0	7.0	--	--	--	--	--	--	--	--	--	3.5	8.0
		2 mo.	7.0	8.5	9.5	10.0	8.5	8.5	--	--	--	--	6.0	7.0	--	--	--	7.0	9.0
		3 mo.	7.3	8.0	9.7	10.0	7.3	6.7	--	--	--	--	--	--	--	--	2.7	4.7	8.7
		4 mo.	8.0	8.0	10.0	10.0	8.0	8.0	--	--	--	--	--	--	10.0	10.0	3.0	3.0	8.0
		5 mo.	7.5	8.0	10.0	10.0	3.0	3.0	--	--	--	--	--	--	10.0	10.0	1.0	3.0	8.0
		6 mo.	8.0	8.0	10.0	10.0	2.0	2.0	--	--	--	--	--	--	10.0	10.0	1.0	2.0	8.0

TABLE 16 (Cont.): SERIES IV H, SYSTEMICS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre		Period after Treat.	Ohia V	Ohia I	Melastoma V	Melastoma I	Lantana V	Lantana I	Waiwi V	Waiwi I	Guava V	Guava I	Aiea V	Aiea I	Ohia Ha V	Ohia Ha I	Tree Fern V	Tree Fern I	False Staghorn Injury
3	M 3142	3	1 wk.	1.0	1.0	1.8	3.5	1.5	1.8	--	--	--	--	1.0	1.5	1.0	1.5	1.5	1.5	2.5
			3 wk.	1.5	3.0	7.0	9.5	9.5	10.0	--	--	--	--	1.0	1.0	--	--	1.0	3.0	8.0
			1 mo.	2.0	3.5	8.5	10.0	9.0	10.0	--	--	2.0	5.0	2.0	3.5	2.0	4.0	--	3.0	8.5
			2 mo.	7.5	8.5	9.5	10.0	10.0	10.0	--	--	--	--	5.5	6.5	--	--	--	4.0	9.5
			3 mo.	8.0	9.0	9.7	10.0	9.7	9.7	--	--	--	--	9.0	9.0	--	--	3.3	6.3	9.3
			4 mo.	9.0	9.0	10.0	10.0	10.0	9.0	--	--	--	--	10.0	9.0	--	--	4.0	5.0	9.0
			5 mo.	9.0	9.0	10.0	10.0	7.0	7.0	--	--	--	--	10.0	10.0	--	--	1.0	5.0	9.5
			6 mo.	10.0	10.0	10.0	10.0	2.5	2.5	--	--	--	--	10.0	10.0	--	--	1.0	2.0	9.0
4	M 3142	6	1 wk.	1.0	1.0	2.0	3.3	1.0	1.5	--	--	1.0	1.5	1.0	1.5	--	--	1.0	2.0	2.8
			3 wk.	1.0	2.5	7.0	9.5	9.0	10.0	--	--	2.0	4.0	1.0	1.0	1.0	2.0	1.0	3.0	5.5
			1 mo.	2.0	3.5	8.5	10.0	9.5	10.0	7.5	7.5	2.0	5.0	1.5	3.0	2.0	3.0	--	3.0	8.5
			2 mo.	7.5	8.5	9.5	10.0	8.5	8.5	--	--	5.0	6.0	8.0	8.0	--	--	--	4.0	9.0
			3 mo.	8.0	9.0	10.0	9.7	9.0	9.0	9.0	9.0	8.0	9.0	8.0	8.0	--	--	2.7	6.0	8.3
			4 mo.	9.0	9.0	10.0	10.0	10.0	9.0	--	--	9.0	9.0	10.0	10.0	10.0	10.0	3.0	4.0	8.0
			5 mo.	9.0	9.0	10.0	10.0	7.0	7.0	--	--	9.5	9.0	10.0	10.0	--	--	1.0	4.0	9.5
			6 mo.	10.0	10.0	10.0	10.0	7.0	7.0	--	--	9.0	7.5	10.0	10.0	10.0	10.0	1.0	1.0	9.0

TABLE 16 (Cont.): SERIES IV H, SYSTEMICS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia		Melastoma		Lantana		Waiwi		Guava		Aiea		Ohia Ha		Tree Fern		False Staghorn Injury
			V	I	V	I	V	I	V	I	V	I	V	I	V	I	V	I	
5	M 3142 + Silvex 3 + 9	1 wk.	1.0	1.0	1.8	3.5	1.5	1.8	1.0	1.0	1.0	1.0	1.0	1.3	--	--	2.5	2.8	2.5
		3 wk.	1.0	3.0	7.0	9.5	10.0	10.0	--	--	4.0	6.0	--	--	1.0	2.5	2.0	4.5	7.0
		1 mo.	2.5	4.0	8.5	10.0	9.5	10.0	--	--	2.0	4.0	1.5	3.0	1.0	2.5	--	4.5	8.0
		2 mo.	7.5	8.5	9.5	10.0	8.5	8.5	--	--	10.0	10.0	7.0	8.0	6.0	8.0	--	5.5	9.0
		3 mo.	7.7	8.7	9.0	10.0	8.3	7.7	--	--	10.0	10.0	7.0	8.0	8.5	9.0	2.7	5.7	8.7
		4 mo.	9.0	9.0	10.0	9.0	7.0	7.0	--	--	10.0	10.0	--	--	10.0	10.0	4.0	4.0	9.0
		5 mo.	8.0	7.5	10.0	9.5	3.0	3.0	--	--	10.0	10.0	--	--	10.0	10.0	2.5	4.5	8.5
		6 mo.	8.5	8.5	10.0	10.0	3.0	3.0	--	--	7.5	7.0	--	--	10.0	10.0	2.0	3.0	9.0
6	M 3142 + ORANGE 3 + 18	1 wk.	1.3	1.5	2.0	3.8	2.0	3.0	1.0	1.0	1.0	1.5	1.0	1.0	1.0	1.0	1.0	1.8	3.0
		3 wk.	1.5	3.5	6.0	10.0	9.0	10.0	--	--	4.5	6.5	1.0	1.5	1.0	2.0	1.0	3.5	7.0
		1 mo.	3.0	4.5	8.5	10.0	9.5	10.0	7.5	7.5	4.0	5.0	1.0	3.0	1.0	2.5	--	3.5	8.0
		2 mo.	7.0	8.0	9.5	10.0	9.5	10.0	--	--	6.5	8.0	7.0	8.0	4.0	5.0	--	5.5	9.5
		3 mo.	7.3	8.3	9.7	9.7	9.7	9.3	--	--	10.0	10.0	6.0	7.0	7.0	8.0	2.7	5.0	9.7
		4 mo.	9.0	9.0	10.0	10.0	10.0	9.0	--	--	10.0	10.0	10.0	10.0	10.0	10.0	4.0	4.0	9.0
		5 mo.	9.0	9.0	10.0	10.0	3.5	3.5	--	--	10.0	10.0	10.0	10.0	10.0	10.0	1.5	1.5	9.5
		6 mo.	9.0	9.0	10.0	10.0	4.0	4.0	--	--	10.0	10.0	7.0	7.0	10.0	10.0	1.0	2.0	9.5

TABLE 16 (Cont.): SERIES IV H, SYSTEMICS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia V	Ohia I	Melastoma V	Melastoma I	Lantana V	Lantana I	Waiwi V	Waiwi I	Guava V	Guava I	Aiea V	Aiea I	Ohia Ha V	Ohia Ha I	Tree Fern V	Tree Fern I	False Staghorn Injury
7	M 3140 3+ 12	1 wk.	1.0	1.3	1.8	3.5	2.0	2.5	1.0	1.0	1.3	2.0	1.0	2.0	1.0	1.0	1.0	1.0	2.8
		3 wk.	1.5	3.0	7.0	10.0	9.5	10.0	6.5	7.5	5.5	7.0	1.0	2.0	1.0	1.5	2.0	3.5	7.0
		1 mo.	3.0	4.5	8.5	10.0	9.5	10.0	9.0	9.0	6.5	9.0	1.0	4.0	1.5	3.0	--	2.0	8.5
		2 mo.	7.5	8.5	9.5	10.0	9.5	9.5	10.0	10.0	9.0	9.5	8.0	9.0	9.0	10.0	--	4.5	9.5
		3 mo.	8.0	8.7	10.0	10.0	9.7	9.3	10.0	9.5	10.0	9.7	9.0	9.0	10.0	10.0	2.5	6.0	9.7
		4 mo.	9.0	9.0	10.0	10.0	10.0	10.0	9.0	9.0	10.0	10.0	10.0	10.0	10.0	10.0	4.0	4.0	9.0
		5 mo.	9.0	9.0	10.0	10.0	4.5	4.5	9.0	8.5	9.0	9.0	--	--	10.0	10.0	1.0	5.0	9.5
		6 mo.	9.5	9.5	10.0	10.0	8.5	8.5	4.0	4.0	9.0	9.0	--	--	9.5	9.5	1.0	3.0	9.5
8	M 3140 4.5+ 18	1 wk.	1.0	1.3	2.3	4.8	2.3	3.3	1.0	2.0	1.3	2.5	1.5	2.5	1.0	2.0	1.0	1.0	3.5
		3 wk.	2.0	3.5	7.0	10.0	--	--	9.0	9.5	3.5	6.5	--	--	--	--	1.0	3.0	9.0
		1 mo.	3.0	5.0	8.5	10.0	9.5	10.0	10.0	10.0	6.0	8.0	1.0	3.0	--	--	--	3.0	8.5
		2 mo.	7.5	8.5	9.5	10.0	10.0	10.0	10.0	10.0	9.0	9.5	6.0	7.0	--	--	--	--	9.5
		3 mo.	7.7	8.3	10.0	9.7	9.7	9.3	10.0	10.0	10.0	9.7	7.0	8.0	--	--	3.0	6.3	9.7
		4 mo.	9.0	9.0	10.0	10.0	10.0	10.0	10.0	10.0	--	--	10.0	9.0	10.0	9.0	5.0	5.0	9.0
		5 mo.	9.0	9.0	10.0	10.0	4.5	4.5	9.0	9.0	9.5	9.0	--	--	9.0	9.0	2.0	4.5	9.5
		6 mo.	9.0	9.0	10.0	10.0	8.5	8.0	9.0	8.5	8.0	8.0	--	--	9.0	9.0	1.0	3.0	10.0

TABLE 16 (Cont.): SERIES IV H, SYSTEMICS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia V	Ohia I	Melastoma V	Melastoma I	Lantana V	Lantana I	Waiwi V	Waiwi I	Guava V	Guava I	Aiea V	Aiea I	Ohia Ha V	Ohia Ha I	Tree Fern V	Tree Fern I	False Staghorn Injury
9	M 3140 + Dowco 224 2 + 16	1 wk.	1.0	1.3	1.5	3.8	1.3	2.0	1.0	2.0	1.3	2.5	1.5	2.0	1.0	2.0	1.0	1.0	2.5
		3 wk.	1.5	3.0	5.5	8.5	8.0	8.5	--	--	2.5	5.0	--	--	1.0	2.5	1.0	2.5	5.0
		1 mo.	2.5	4.0	7.0	9.0	7.0	7.0	7.5	7.5	5.0	6.5	4.0	7.0	4.0	6.0	--	3.5	5.5
		2 mo.	3.5	5.0	8.5	9.0	7.5	8.0	--	--	9.5	9.5	9.0	10.0	5.0	5.5	--	4.0	6.5
		3 mo.	4.0	5.0	9.7	9.0	7.7	7.0	9.0	7.0	9.0	8.7	--	--	8.0	8.0	--	--	7.3
		4 mo.	4.0	6.0	9.0	8.0	5.0	5.0	--	--	10.0	10.0	--	--	3.0	3.0	2.0	3.0	7.0
		5 mo.	3.5	5.0	6.0	7.0	2.0	2.0	--	--	3.0	3.0	--	--	3.0	3.0	1.0	1.0	7.5
		6 mo.	3.5	4.5	6.5	6.5	1.5	1.5	--	--	4.0	4.0	3.0	3.0	1.0	1.0	1.0	2.0	3.5
10	ORANGE (M 3151) 16 a.e.	1 wk.	1.5	2.0	1.5	4.5	2.5	4.0	--	--	1.0	1.3	2.0	3.5	1.0	2.0	1.0	1.7	3.5
		3 wk.	3.0	4.5	6.5	10.0	9.5	10.0	--	--	9.0	9.5	--	--	1.5	3.0	1.0	3.0	7.5
		1 mo.	3.5	5.5	8.5	10.0	9.5	10.0	--	--	8.0	9.5	6.0	9.0	2.0	3.0	--	3.0	8.5
		2 mo.	7.5	8.0	9.5	10.0	10.0	10.0	--	--	9.0	9.0	8.0	9.0	--	--	--	3.0	9.0
		3 mo.	7.7	8.3	9.3	10.0	9.3	8.3	--	--	10.0	10.0	9.0	9.0	--	--	2.5	4.0	9.7
		4 mo.	9.0	8.0	10.0	10.0	8.0	7.0	--	--	9.0	9.0	10.0	10.0	9.0	9.0	1.0	1.0	9.0
		5 mo.	7.0	8.0	10.0	9.5	3.0	3.0	--	--	8.5	8.0	--	--	8.0	8.0	1.0	1.0	9.0
		6 mo.	8.0	8.0	9.5	9.5	2.0	2.0	--	--	8.0	8.0	--	--	4.0	4.0	1.0	1.0	9.5

TABLE 16 (Cont.): SERIES IV H, SYSTEMICS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia V	Ohia I	Melastoma V	Melastoma I	Lantana V	Lantana I	Waiwi V	Waiwi I	Guava V	Guava I	Aiea V	Aiea I	Ohia Ha V	Ohia Ha I	Tree Fern V	Tree Fern I	False Staghorn Injury
11	ORANGE (M 3151)	1 wk.	1.5	2.0	2.8	6.0	3.0	3.3	5.0	6.0	1.3	2.0	1.0	4.0	1.0	3.0	1.0	2.3	3.8
	24 a.e.	3 wk.	3.0	4.5	6.5	10.0	--	--	9.0	9.5	6.5	8.0	3.0	4.0	2.0	4.0	2.0	4.0	7.5
		1 mo.	3.5	5.5	8.5	10.0	9.5	10.0	10.0	10.0	8.0	9.5	3.0	5.0	--	--	--	3.0	8.5
		2 mo.	7.5	8.5	9.5	10.0	9.5	9.5	10.0	10.0	9.5	9.5	10.0	10.0	--	--	--	5.5	9.5
		3 mo.	7.7	8.3	10.0	10.0	9.3	8.3	10.0	10.0	9.7	9.3	10.0	10.0	9.0	9.0	1.7	5.3	9.3
		4 mo.	8.0	8.0	10.0	10.0	8.0	7.0	10.0	9.0	10.0	10.0	10.0	10.0	--	--	3.0	4.0	9.0
		5 mo.	7.0	7.0	10.0	10.0	3.0	3.0	9.0	9.0	9.0	8.0	10.0	10.0	4.0	4.0	1.5	1.5	9.0
		6 mo.	8.0	7.5	9.5	9.5	2.0	2.0	7.5	7.5	8.5	8.0	10.0	10.0	10.0	10.0	1.0	2.5	9.0
12	TORDON 22K +	1 wk.	1.5	2.5	3.7	6.3	3.0	3.3	3.0	4.5	1.0	2.0	1.0	2.0	1.3	2.0	1.5	2.0	3.0
	ORANGE 4 + 8	3 wk.	3.5	5.5	6.5	10.0	9.0	10.0	7.5	8.0	5.0	7.5	3.0	4.0	4.0	6.0	1.0	3.5	6.0
		1 mo.	4.5	7.0	8.5	10.0	9.5	10.0	9.0	9.0	5.5	8.5	3.0	5.0	4.0	7.0	--	4.5	8.0
		2 mo.	8.5	9.5	9.5	10.0	9.5	9.5	10.0	10.0	9.5	9.5	8.0	8.0	8.0	8.0	--	4.0	9.5
		3 mo.	8.0	8.3	9.7	9.3	9.7	9.0	7.0	7.5	9.7	9.7	9.5	9.0	7.5	8.5	2.0	5.0	8.7
		4 mo.	9.0	9.0	10.0	10.0	10.0	9.0	4.0	5.0	10.0	10.0	10.0	9.0	9.0	9.0	3.0	4.0	9.0
		5 mo.	9.0	9.0	10.0	10.0	4.5	4.5	4.5	3.5	9.5	9.0	8.0	8.0	8.0	8.0	1.0	1.0	9.0
		6 mo.	9.0	9.0	9.5	9.5	4.0	4.0	4.0	4.0	8.5	8.0	8.0	8.0	8.0	8.0	1.0	2.5	8.5

TABLE 16 (Cont.): SERIES IV H, SYSTEMICS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia V	Ohia I	Melastoma V	Melastoma I	Lantana V	Lantana I	Waiwi V	Waiwi I	Guava V	Guava I	Aiea V	Aiea I	Ohia Ha V	Ohia Ha I	Tree Fern V	Tree Fern I	False Staghorn Injury
13	TORDON 22K + Diquat 3 + 3	1 wk.	2.8	7.0	3.7	6.3	3.0	3.3	3.0	4.5	1.0	2.0	1.0	2.0	1.3	2.0	1.5	2.0	3.0
		3 wk.	5.5	8.5	6.5	10.0	9.0	10.0	7.5	8.0	5.0	7.5	3.0	4.0	4.0	6.0	1.0	3.5	6.0
		1 mo.	8.0	9.0	8.5	10.0	9.5	10.0	9.0	9.0	5.5	8.5	3.0	5.0	4.0	7.0	--	4.5	8.0
		2 mo.	8.5	9.5	9.5	10.0	9.5	9.5	10.0	10.0	9.5	9.5	8.0	8.0	8.0	8.0	--	4.0	9.5
		3 mo.	9.0	9.3	9.7	9.3	9.7	9.0	7.0	7.5	9.7	9.7	9.5	9.0	7.5	8.5	2.0	5.0	8.7
		4 mo.	9.0	9.0	10.0	10.0	10.0	8.0	3.0	4.0	8.0	9.0	10.0	10.0	10.0	10.0	8.0	8.0	8.0
		5 mo.	8.5	8.5	10.0	10.0	3.0	3.0	3.0	3.0	6.5	6.0	10.0	10.0	10.0	10.0	2.0	2.0	8.0
		6 mo.	8.0	8.5	10.0	9.0	2.0	2.0	1.5	1.5	4.0	5.0	10.0	10.0	10.0	10.0	2.0	2.0	6.5

TABLE 17: SERIES IV M, SYSTEMICS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia V	Ohia I	Lantana V	Lantana I	Guava V	Guava I	Java-plum V	Java-plum I	Hau V	Hau I	Christmas-berry V	Christmas-berry I	Hilograss Injury	Yellow Foxtail Injury	Molasses Grass Injury	Ricegrass Injury
14	M 3189 2+13	1 wk.	1.0	1.0	3.0	4.0	2.5	3.5	2.5	3.5	--	--	--	--	3.0	2.5	5.5	3.0
		2 wk.	2.0	2.5	2.0	3.0	3.5	4.0	3.0	4.0	--	--	1.0	1.0	3.0	2.0	6.	1.5
		3 wk.	4.0	6.5	5.0	5.0	6.0	6.0	3.0	5.0	--	--	--	--	4.0	4.0	8.0	4.0
		1 mo.	6.5	7.5	7.5	7.5	7.0	7.5	6.5	7.5	--	--	5.0	5.5	4.5	3.0	8.5	2.5
		2 mo.	7.0	8.0	7.5	7.5	6.5	7.0	6.5	7.5	--	--	6.5	7.0	4.0	7.5	9.5	7.0
		3 mo.	3.0	5.0	3.5	4.0	2.5	2.5	6.0	7.0	--	--	4.0	5.0	2.5	2.5	7.0	2.0
		4 mo.	9.0	9.0	3.0	3.5	3.0	3.0	7.0	7.0	--	--	7.5	7.0	1.0	1.0	4.5	1.0
		5 mo.	7.0	8.5	1.5	2.0	2.0	2.5	7.0	6.5	--	--	5.0	5.0	1.0	1.0	1.0	1.0
		6 mo.	7.0	7.0	1.5	2.0	1.5	1.5	6.0	6.0	--	--	5.0	5.0	1.0	1.0	1.0	1.0
15	M 3189 3+19.5	1 wk.	1.0	1.0	1.5	2.0	2.5	3.5	1.5	2.5	1.5	4.5	2.0	3.0	2.0	1.5	3.0	2.0
		2 wk.	2.0	2.5	1.5	2.5	3.5	4.0	1.5	2.5	1.5	2.5	5.0	5.5	2.5	2.0	5.5	2.0
		3 wk.	2.5	4.0	4.5	5.0	5.5	5.5	2.5	4.5	2.0	3.0	8.0	9.5	4.0	4.5	8.0	4.0
		1 mo.	5.5	6.5	7.0	7.5	8.0	8.5	5.0	7.5	3.0	3.5	9.5	9.5	5.0	4.0	7.5	4.0
		2 mo.	8.0	9.0	6.5	7.0	8.0	8.5	6.5	7.5	3.0	4.0	10.0	10.0	5.0	8.0	9.0	7.5
		3 mo.	4.0	5.5	4.0	5.0	4.5	5.5	9.0	9.0	3.0	3.0	9.0	9.0	3.0	3.0	8.0	3.0
		4 mo.	5.0	5.5	3.5	3.5	3.0	3.0	9.5	9.0	--	--	8.0	8.0	1.0	1.0	3.5	1.0
		5 mo.	6.0	7.0	1.5	1.5	1.5	1.5	9.5	9.0	--	--	8.0	8.0	1.0	1.0	1.0	1.0
		6 mo.	7.0	7.0	1.5	1.5	1.0	1.0	9.0	8.0	--	--	8.0	7.5	1.0	1.0	1.0	1.0

TABLE 17 (Cont.): SERIES IV M, SYSTEMICS
VISIBILITY AND INJURY RATINGS

Treat. No.	Chemical and rate in lb/acre	Period after Treat.	Ohia V	Ohia I	Lantana V	Lantana I	Guava V	Guava I	Java-plum V	Java-plum I	Hau V	Hau I	Christmas-berry V	Christmas-berry I	Hilograss Injury	Yellow Foxtail Injury	Molasses Grass Injury	Ricegrass Injury
16	M 3189 4 + 26	1 wk.	1.0	1.0	3.0	3.5	2.5	4.0	2.0	3.0	2.0	6.0	--	--	4.0	4.0	4.5	2.5
		2 wk.	2.5	3.0	4.5	5.0	2.5	3.0	2.5	3.5	4.5	6.0	1.0	2.0	3.0	2.5	4.0	2.0
		3 wk.	2.5	3.5	8.0	9.0	5.5	6.5	3.0	4.5	3.5	5.5	7.0	10.0	4.5	5.0	8.0	3.5
		1 mo.	6.0	7.0	9.5	9.5	8.0	9.0	5.5	8.5	7.5	8.5	10.0	10.0	5.5	6.5	8.5	5.0
		2 mo.	8.0	9.5	9.5	9.5	8.5	9.0	9.0	9.5	7.5	7.5	9.5	10.0	5.5	8.5	9.5	8.0
		3 mo.	8.0	9.0	9.0	8.0	6.5	8.0	10.0	9.5	7.0	8.0	9.0	9.0	5.0	9.0	9.0	4.0
		4 mo.	5.0	5.5	5.0	4.5	2.5	2.5	10.0	9.0	7.0	7.0	9.0	9.0	1.0	1.0	3.5	1.0
		5 mo.	8.0	8.0	5.5	4.5	1.5	2.5	10.0	10.0	--	--	8.0	8.0	1.0	1.0	8.0	1.0
		6 mo.	8.0	8.0	4.5	5.5	1.5	2.5	9.5	9.0	--	--	8.0	8.0	1.0	1.0	1.0	1.0
17	M 3190	1 wk.	1.0	1.0	1.0	2.0	1.0	1.5	--	--	1.5	4.0	--	--	1.5	1.5	4.5	2.0
	1.5 + 1.5 + 10.5	2 wk.	1.0	1.5	2.0	2.5	2.0	2.5	1.0	2.0	2.5	4.0	1.0	1.5	2.5	2.0	4.0	2.0
		3 wk.	1.0	2.5	5.5	7.0	4.5	5.0	1.5	3.0	2.0	3.0	2.0	3.0	4.5	3.5	7.0	3.5
		1 mo.	2.5	4.0	7.5	8.0	5.5	6.0	4.0	6.0	3.5	4.0	9.5	9.5	3.5	3.0	8.5	2.5
		2 mo.	3.0	4.5	5.5	6.0	4.0	4.5	5.5	6.5	3.5	4.5	7.0	8.0	4.5	6.0	9.5	5.0
		3 mo.	3.0	5.0	3.5	5.0	4.5	5.5	6.0	7.0	3.0	4.0	8.0	8.0	4.0	3.0	9.0	3.0
		4 mo.	7.0	7.0	3.5	3.5	2.0	2.0	7.0	7.0	--	--	7.0	7.0	1.0	1.0	4.5	2.0
		5 mo.	4.0	4.0	1.5	2.0	1.5	2.5	5.0	5.0	--	--	5.0	5.0	1.0	1.0	7.0	1.0
		6 mo.	4.0	4.0	1.5	2.5	1.0	2.0	3.0	3.0	--	--	2.0	2.0	1.0	1.0	1.0	1.0

TABLE 17 (Cont.): SERIES IV M, SYSTEMICS
VISIBILITY AND INJURY RATINGS

Treat No.	Chemical and rate in lb/acre	Period after Treat.	Ohia V	Ohia I	Lantana V	Lantana I	Guava V	Guava I	Java-plum V	Java-plum I	Hau V	Hau I	Christmas-berry V	Christmas-berry I	Hilograss Injury	Yellow Foxtail Injury	Molasses Grass Injury	Ricegrass Injury
18	M 3190 2-1/4 + 2-1/4 + 15-3/4	1 wk.	1.0	1.0	1.5	2.5	1.0	1.0	1.0	2.0	1.0	2.0	--	--	1.0	1.0	2.5	1.0
		2 wk.	1.0	1.0	2.0	2.5	2.0	2.5	1.0	1.5	2.0	3.5	--	--	1.5	1.5	3.0	1.5
		3 wk.	1.5	2.0	3.5	4.5	6.5	7.5	1.5	3.5	4.0	6.0	--	--	3.0	2.5	5.5	2.0
		1 mo.	4.0	5.0	7.5	8.0	8.0	8.0	4.0	6.5	4.5	5.0	10.0	10.0	4.0	3.5	7.0	3.0
		2 mo.	7.5	9.0	6.5	6.5	5.0	5.5	5.0	6.5	5.5	7.5	8.5	8.5	4.0	7.5	9.5	6.5
		3 mo.	9.0	9.0	3.0	4.5	3.5	4.0	7.0	8.0	7.0	8.0	10.0	10.0	4.0	6.0	6.5	7.0
		4 mo.	8.0	8.0	3.5	3.5	2.5	3.0	7.5	6.5	5.0	5.0	9.0	9.0	2.0	2.0	5.0	2.0
		5 mo.	5.0	5.0	1.5	2.5	1.5	2.0	3.5	4.0	5.0	5.0	8.0	8.0	1.0	1.0	7.0	1.0
		6 mo.	5.0	5.0	2.5	3.0	1.0	2.0	2.0	3.0	5.0	5.0	7.0	6.5	1.0	1.0	1.0	1.0
19	M 3190 3 + 3 + 21	1 wk.	1.0	2.0	3.0	4.0	1.0	2.5	2.0	4.0	1.5	4.5	--	--	3.0	3.0	4.0	2.5
		2 wk.	--	--	1.5	2.5	2.5	3.0	2.5	4.0	2.0	4.5	--	--	2.0	1.5	--	1.5
		3 wk.	2.0	5.0	8.0	8.5	4.0	5.0	2.5	5.5	4.0	7.0	--	--	5.0	4.5	--	4.0
		1 mo.	4.5	6.5	9.0	9.0	8.0	8.5	5.5	8.5	5.5	6.5	8.5	8.5	5.5	7.5	--	4.5
		2 mo.	6.0	7.5	9.5	9.5	8.5	9.0	9.5	9.5	7.5	8.5	9.0	9.0	6.5	9.0	10.0	7.0
		3 mo.	8.0	9.0	7.5	7.5	7.5	6.5	10.0	10.0	8.0	8.0	10.0	10.0	4.5	9.5	--	4.5
		4 mo.	8.0	8.0	4.5	4.0	7.0	7.0	10.0	9.5	9.0	9.0	--	--	2.0	2.0	--	1.5
		5 mo.	7.0	7.0	4.0	5.5	5.5	6.5	9.5	9.0	8.0	8.0	8.0	8.0	1.0	1.0	--	1.0
		6 mo.	7.0	6.0	5.0	5.0	2.0	3.0	8.5	7.5	7.0	7.0	6.0	6.0	1.0	1.0	--	1.0

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13 ABSTRACT

Results of a one-year field investigation on Hawaii jungle vegetation defoliation by aerially applied herbicides are reported. Four test sites were located on the island of Kauai in 90 to 150 inch rainfall zones at elevations of 400 to 1000 feet. Duplicate test plots, 80 to 200 feet wide, nominally two acres in area were used in three sites and unreplicated five-acre plots in one site. Herbicides singly or in various combinations were sprayed in single or multiple passes from a biplane in volumes of about seven gallons per acre, the concentrates with X the estimated critical amount for defoliation. Commercially available herbicides were mostly utilized in about 60 treatments. The vegetation of dense single and some double storied native scrub jungle forest on rough terrain consisted predominantly of scattered Psidium, Metrosideros, Eugenia, Pandanus, Schinus, Grevillea trees; locally dense to scattered stands of Melastoma, Rhodomyrtus, Lantana shrubs; locally dense to scattered stands of Dicranopteris, Nephrolepis ferns and scattered stands of Paspalum, Setaria, Melinis, grasses. Several herbicides provided good to excellent visibility and injury ratings in excess of 65 percent of extended periods starting a few hours or days after treatment. The report comprises a text dealing with the four sites, 17 tables, 19 figures and 38 photographs.

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